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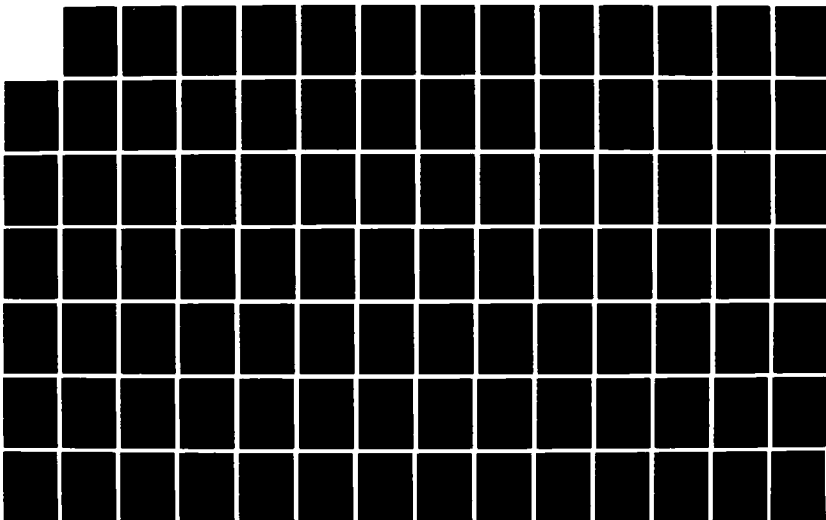
VERTICAL DIRECTIONALITY OF AMBIENT NOISE AT 32 DEG N AS 1/2  
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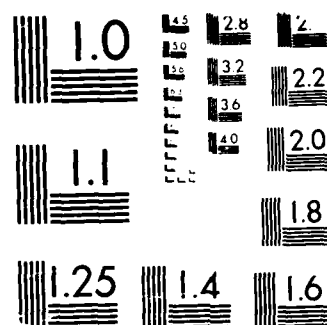
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# MARINE PHYSICAL LABORATORY

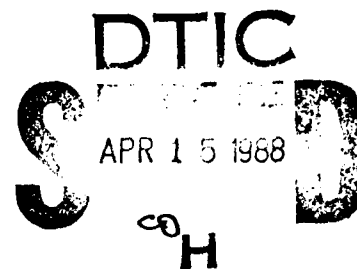
SCRIPPS INSTITUTION OF OCEANOGRAPHY

San Diego, California 92152

AD-A193 231

VERTICAL DIRECTIONALITY OF AMBIENT NOISE  
AT 32° N AS A FUNCTION OF LONGITUDE:  
Tape #85010

W. S. Hodgkiss and F. H. Fisher



MPL TECHNICAL MEMORANDUM 387-B

MPL-U-32/86

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January 1988

## REPORT DOCUMENTATION PAGE

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**Vertical Directionality of Ambient Noise**

**at 32° N as a Function of Longitude:**

**Tape #85010**

W.S. Hodgkiss and F.H. Fisher

Marine Physical Laboratory  
Scripps Institution of Oceanography  
San Diego, CA 92152

**Abstract**

Measurements have been made of the ambient noise field between 25 and 300 Hz with vertical arrays at 32° N (124° W, 136° W, and 150° W). This technical report contains the complete analysis results for the NORDA VEKA 48-element vertical array Tape #85010. The tape was recorded at 32° N, 124° W (approximately 350 nmi due west of San Diego) on 18 October 1985 beginning at 20:05 PDT. At that time, the wind speed was 6 kts.

## I. Introduction

This technical report contains the complete analysis results for the NORDA VEKA 48-element vertical array Tape #85010. The tape was recorded at 32°N, 124°W (approximately 350 nmi due west of San Diego) on 18 October 1985 beginning at 20:05 PDT. At that time, the wind speed was 6 kts.

A complete description of the experiment and data analysis procedure is given in the summary technical report (TM-387-A). Here, a brief guide will be provided to the results documented in the various sections.

Section II (Preliminary Analysis) provides a preliminary look at the data quality from 4 hydrophones spaced approximately equally across the array for the first data segment (65536 points).

The results are ordered as follows:

- (1) Channel means (A/D counts).
- (2) Time series (A/D counts) for the first 1024 points of the first segment.
- (3) Time-varying mean (A/D counts, 64-point averages).
- (4) Time-varying power (A/D counts squared, 64-point averages) (channel means have been removed).
- (5) Power spectra (dB// $\mu$ Pa/ $\sqrt{\text{Hz}}$ ) (channel means have been removed).

Section III (Power Spectra) provides an extended preliminary look at the power spectra from all hydrophones in the array for the first data segment (65536 points). The results are ordered as follows:

- (1) Channel means (A/D counts).
- (2) Power spectra (dB// $\mu$ Pa/ $\sqrt{\text{Hz}}$ ) (channel means have been removed).

Section IV (Array Response: Waterfall, KB Window) provides waterfall plots of the time-evolving vertical directionality of ambient noise for successive segments (65536 points) across the entire data tape (dB// $\mu$ Pa/ $\sqrt{\text{HzDeg}}$ ). A Kaiser-Bessel window ( $\alpha = 1.5$ ) was used to amplitude shade the array elements.

Section V (Array Response: Waterfall, Rect Window) provides waterfall plots of the time-evolving

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vertical directionality of ambient noise for successive segments (65536 points) across the entire data tape ( $\text{dB}/\mu\text{Pa}/\sqrt{\text{HzDeg}}$ ). A rectangular window was used to amplitude shade the array elements.

Section VI (Array Response: Panels, KB Window) provides multi-panel plots of the time-evolving vertical directionality of ambient noise for successive segments (65536 points) across the entire data tape ( $\text{dB}/\mu\text{Pa}/\sqrt{\text{HzDeg}}$ ). A Kaiser-Bessel window ( $\alpha = 1.5$ ) was used to amplitude shade the array elements.

Section VII (Array Response: Panels, Rect Window) provides multi-panel plots of the time-evolving vertical directionality of ambient noise for successive segments (65536 points) across the entire data tape ( $\text{dB}/\mu\text{Pa}/\sqrt{\text{HzDeg}}$ ). A rectangular window was used to amplitude shade the array elements.

## II. Preliminary Analysis.



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Channel #16

1 -7.2846832275391

Channel #32

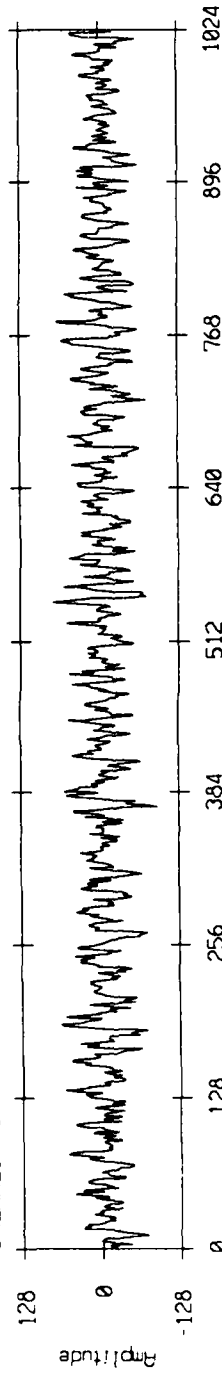
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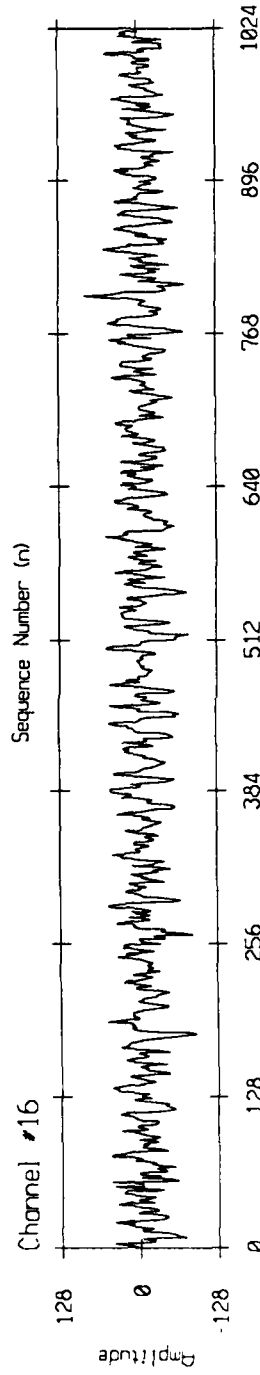
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Time Series - 85010.1

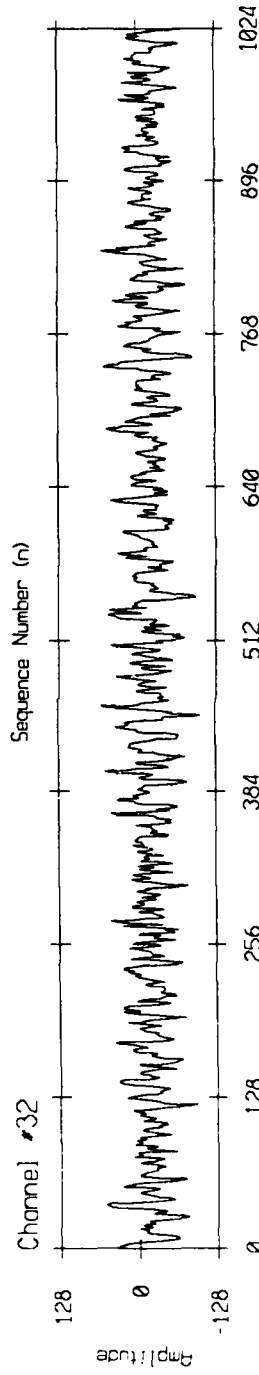
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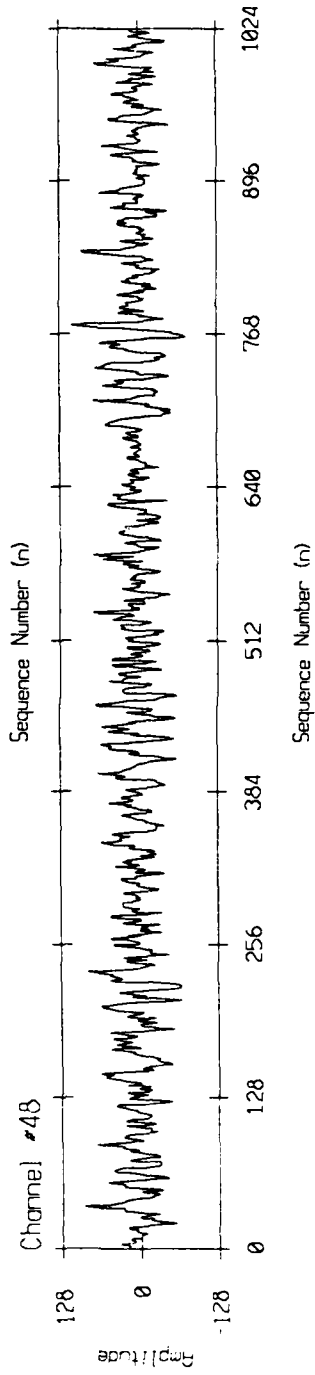
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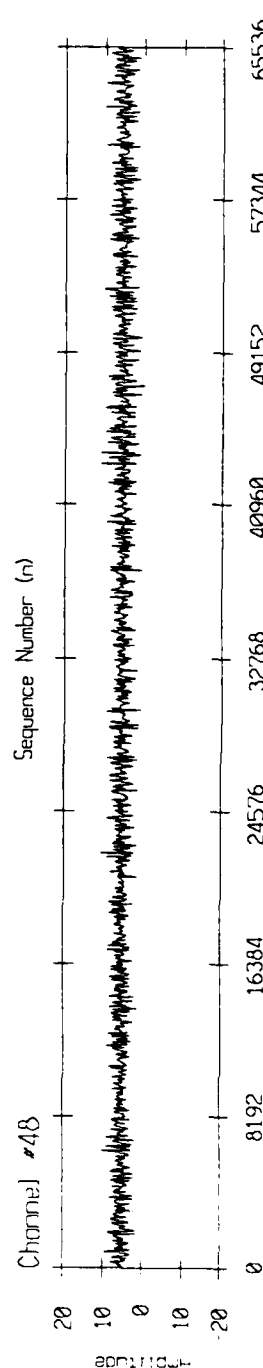
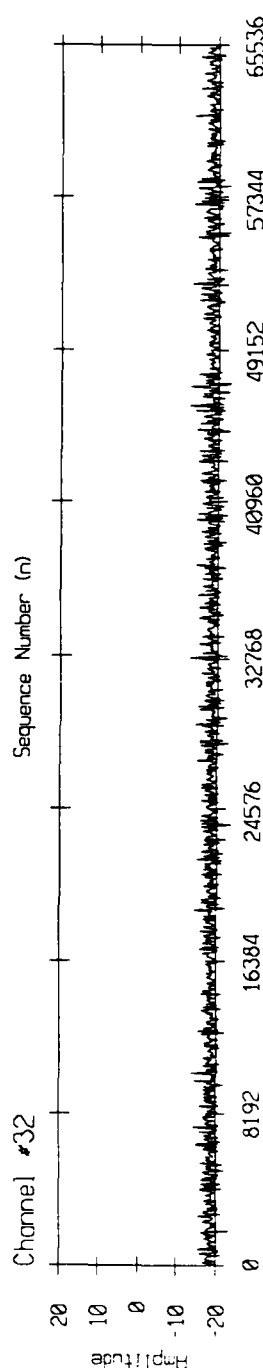
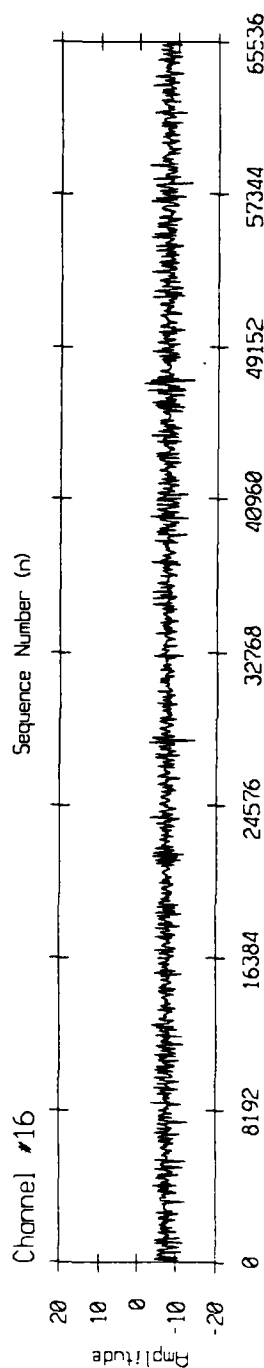
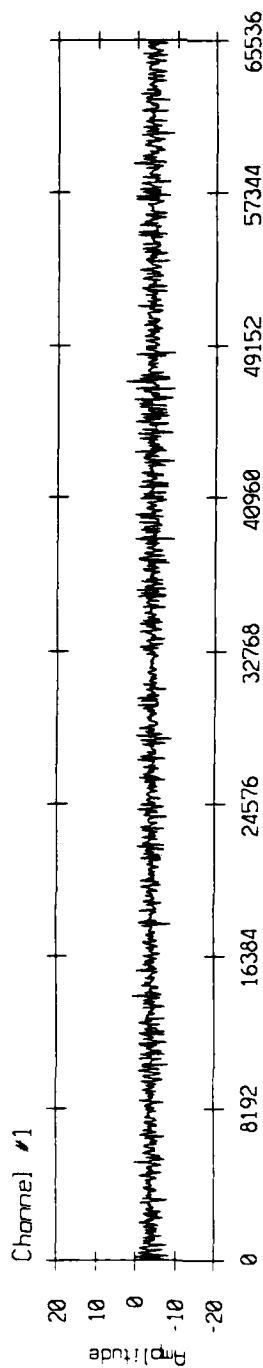
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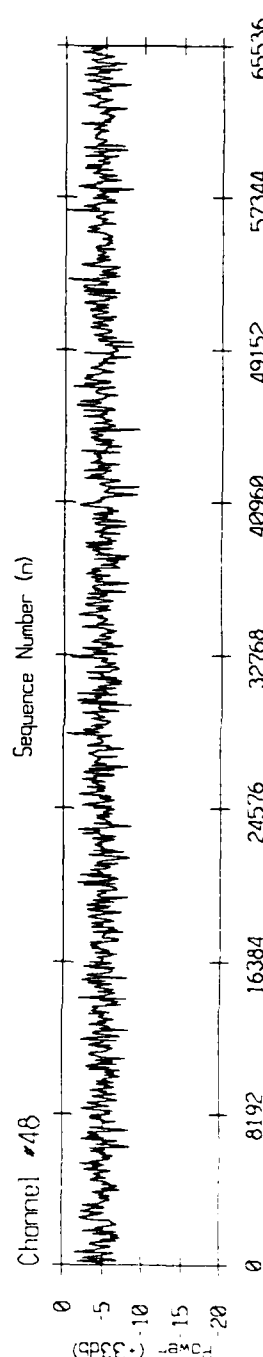
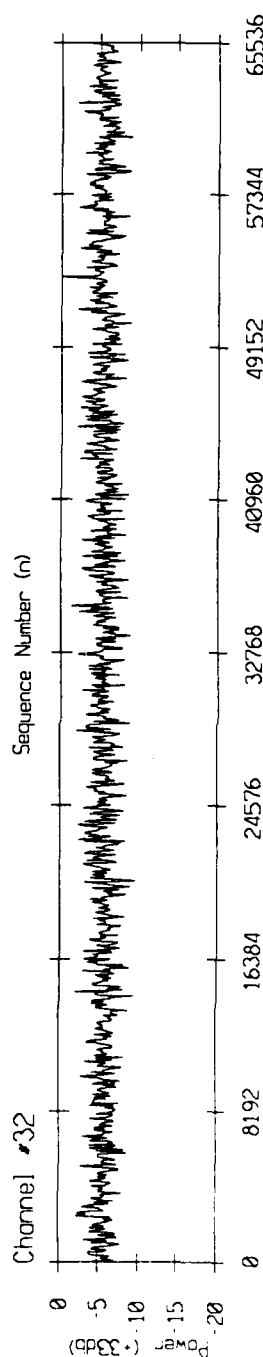
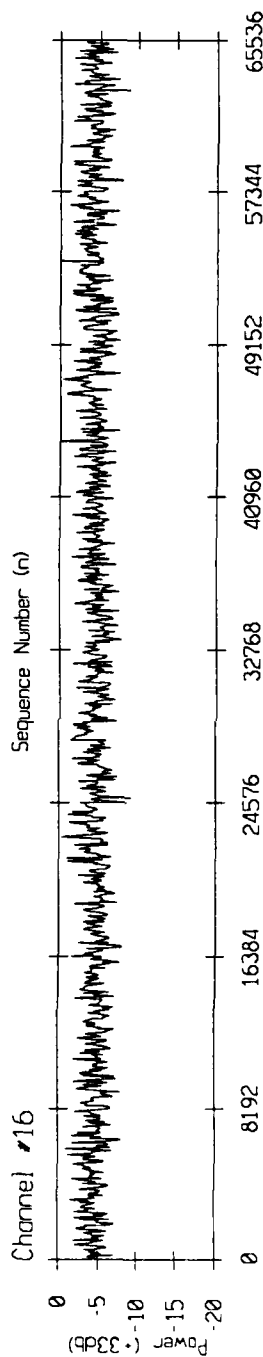
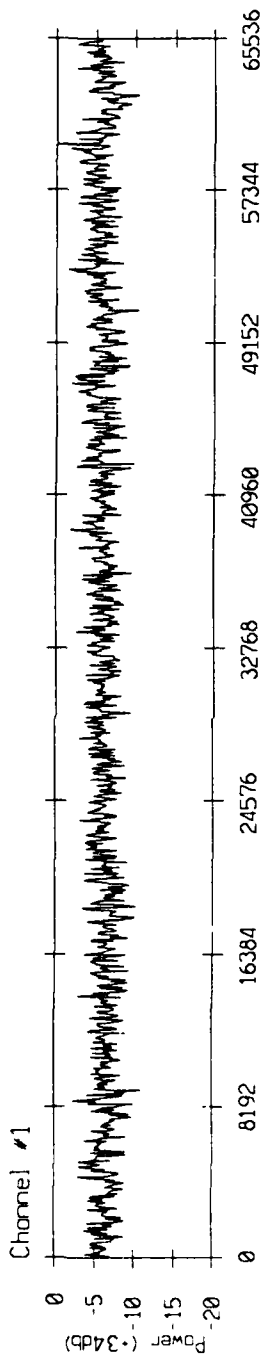
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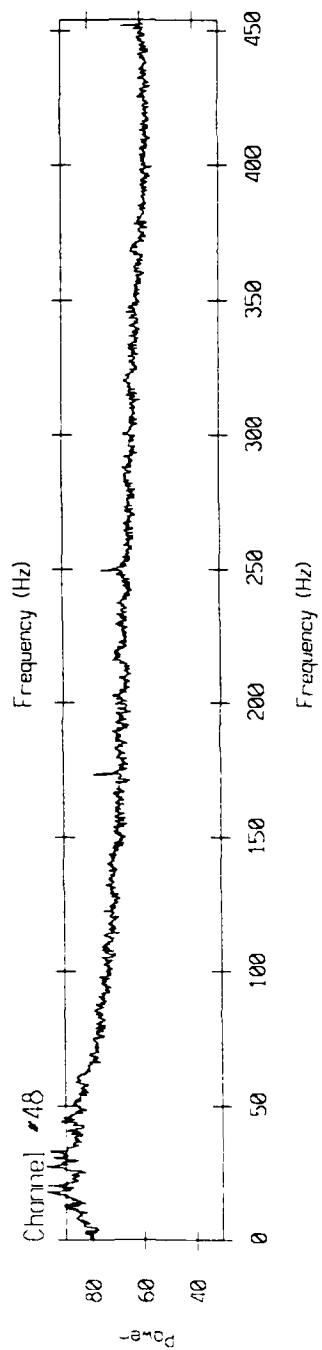
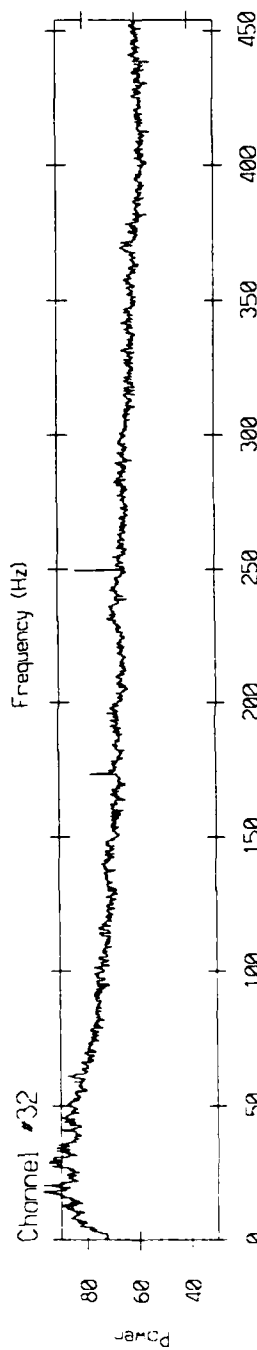
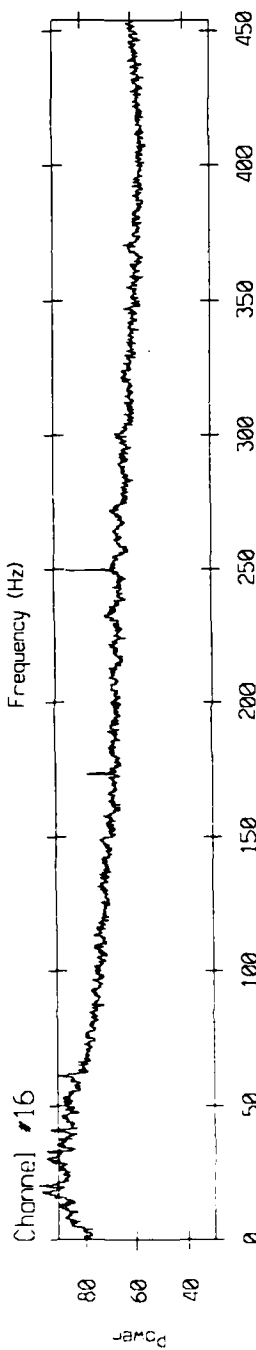
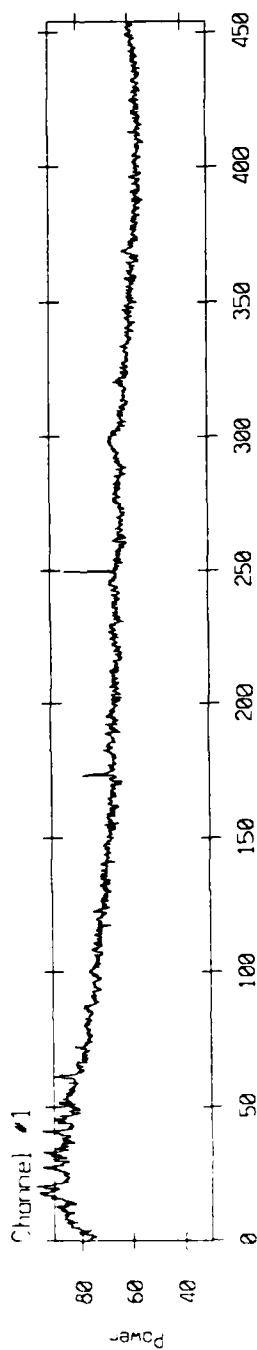
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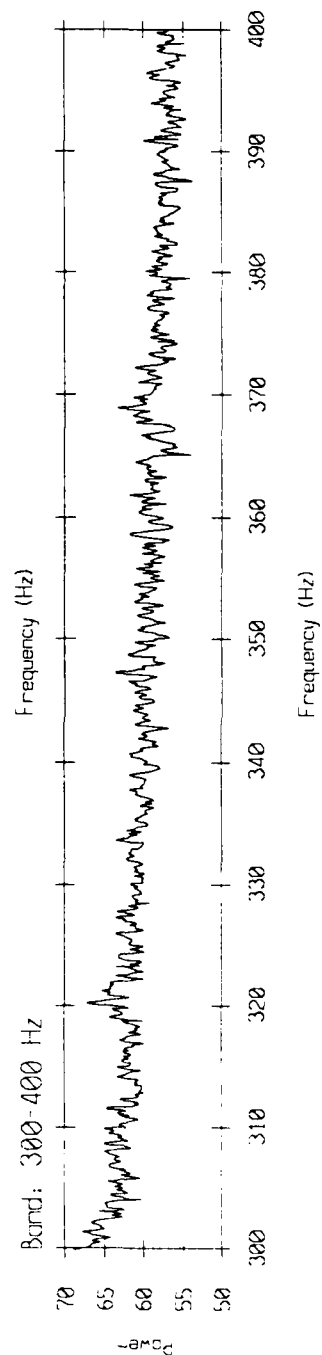
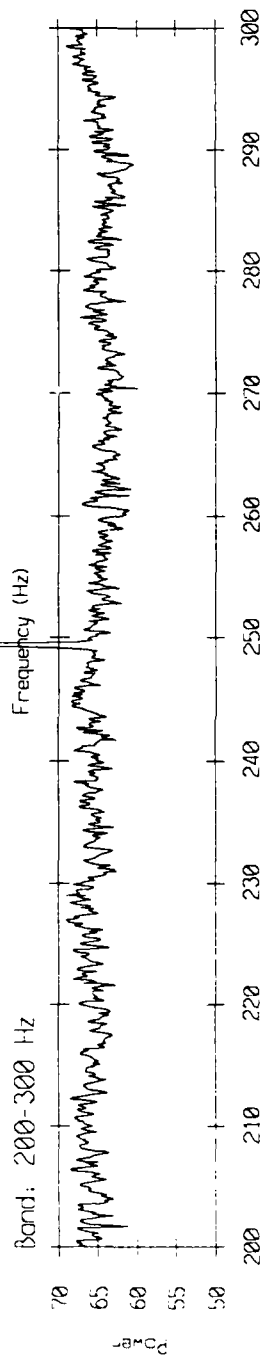
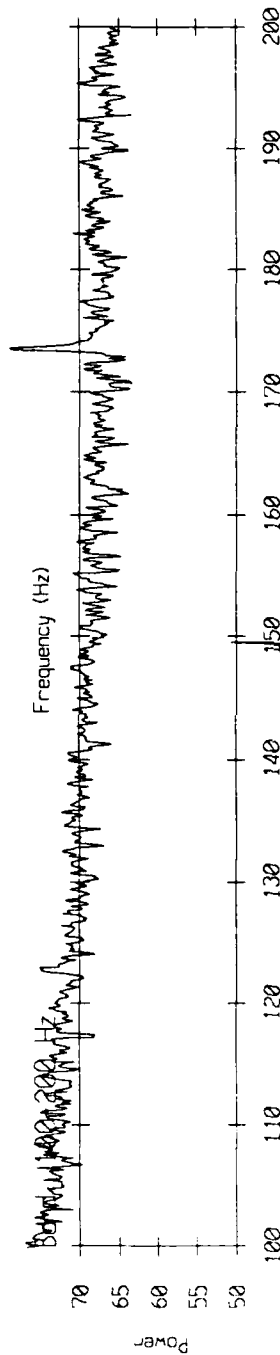
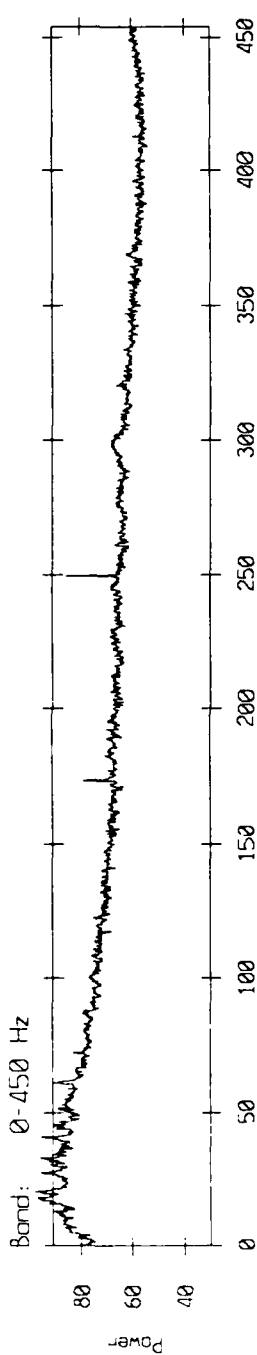
# Time Series Power - 85010.1



Power Spectrum - 85010.1

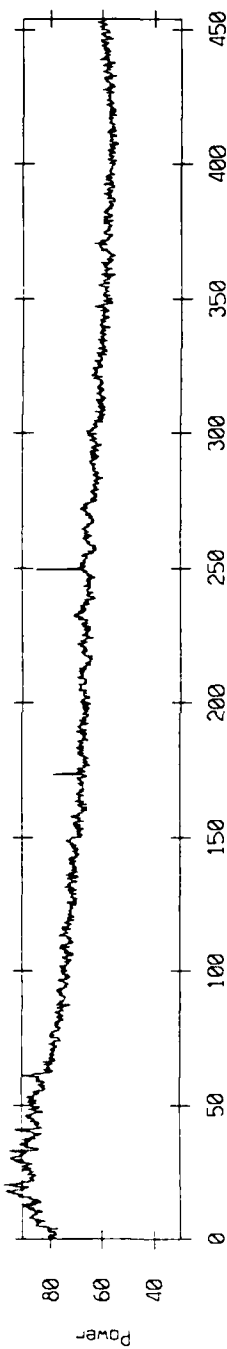


Power Spectrum - 85010.1 Channel #1

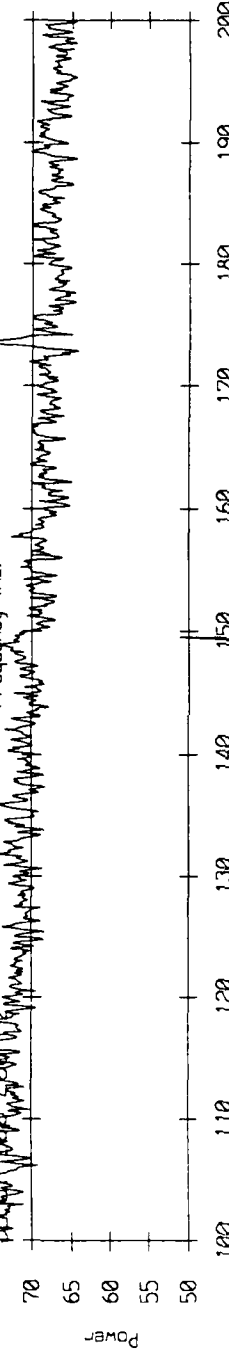


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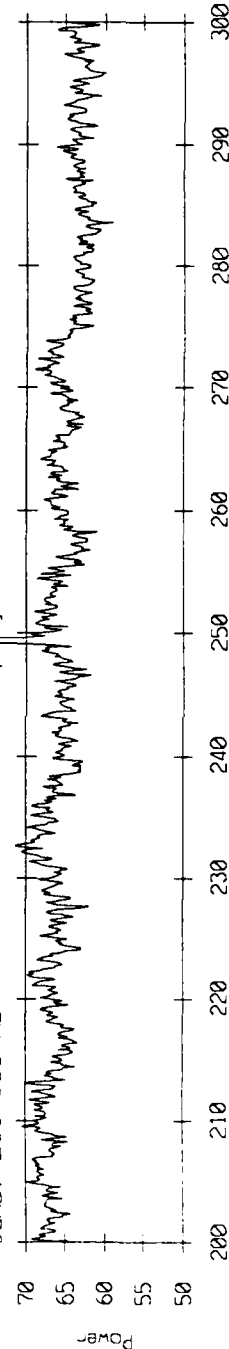
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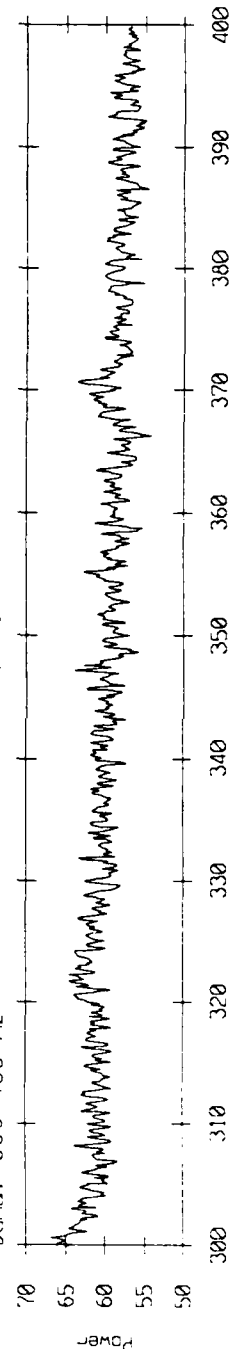
Band: 200-300 Hz



Band: 200-300 Hz

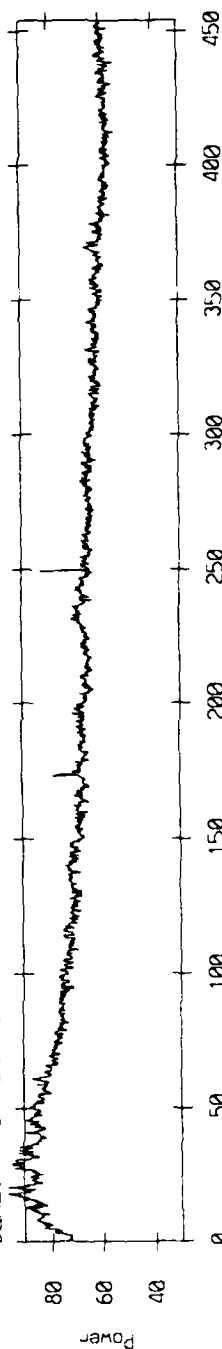


Band: 300-400 Hz



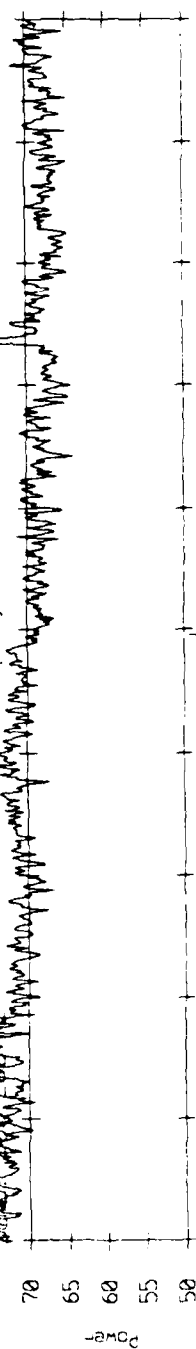
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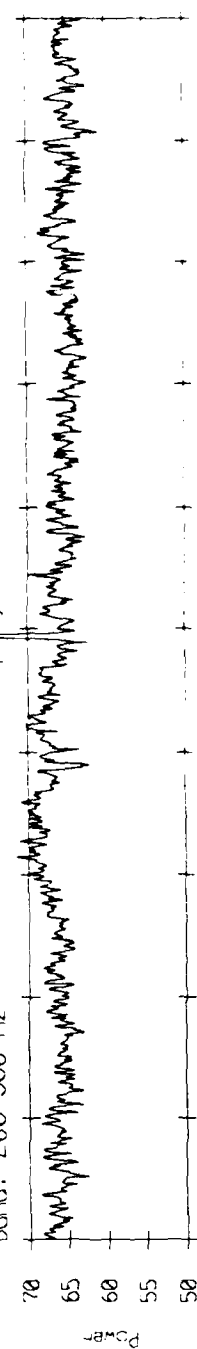
Frequency (Hz)

Band: 200-300 Hz



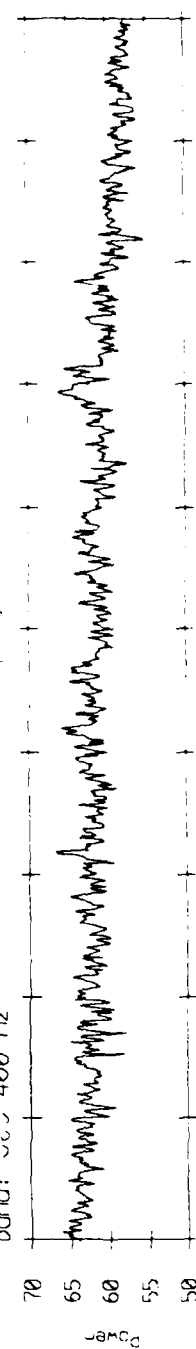
Frequency (Hz)

Band: 200-300 Hz



Frequency (Hz)

Band: 200-300 Hz



Frequency (Hz)

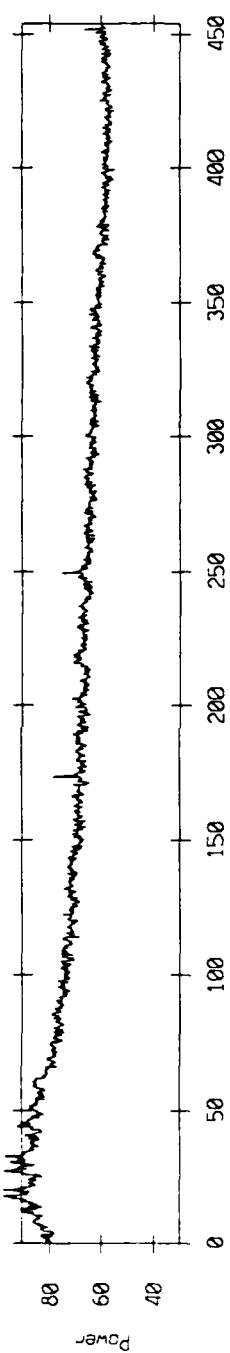
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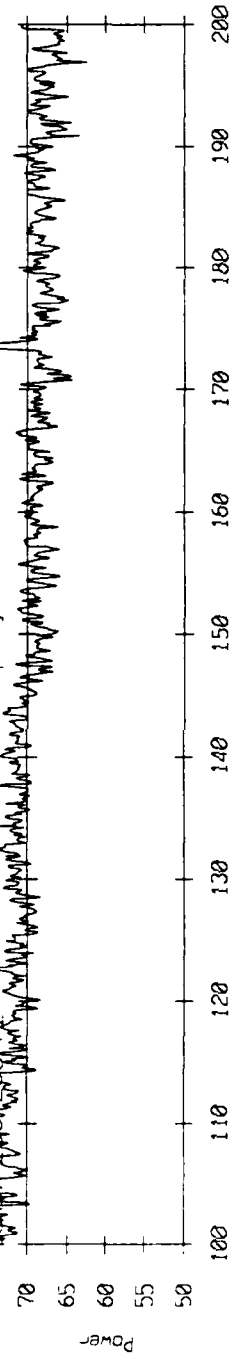


Power Spectrum - 85010.1 Channel #48

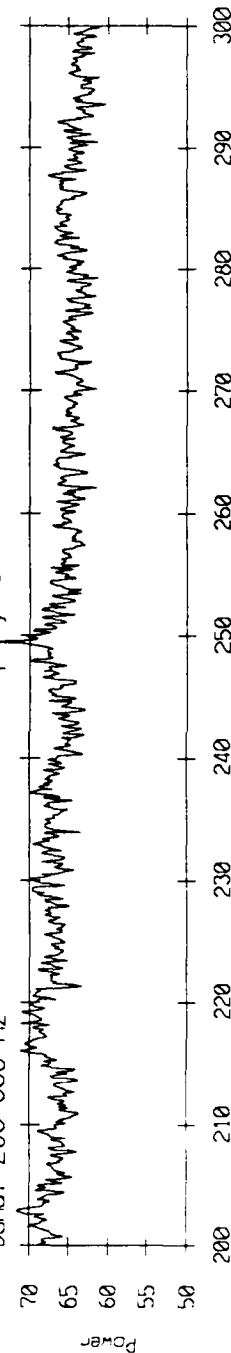
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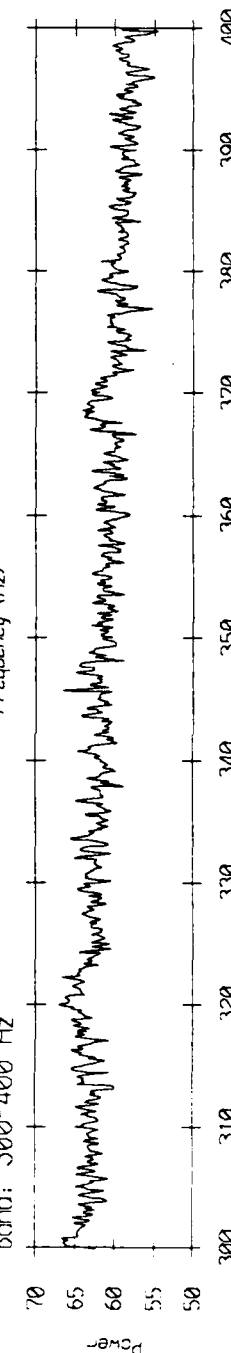
Band: 200-300 Hz



Band: 200-300 Hz



Band: 300-400 Hz

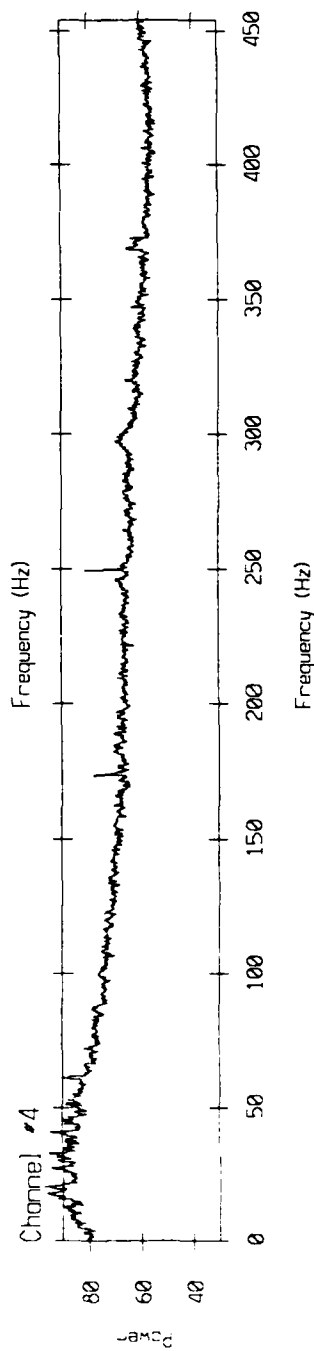
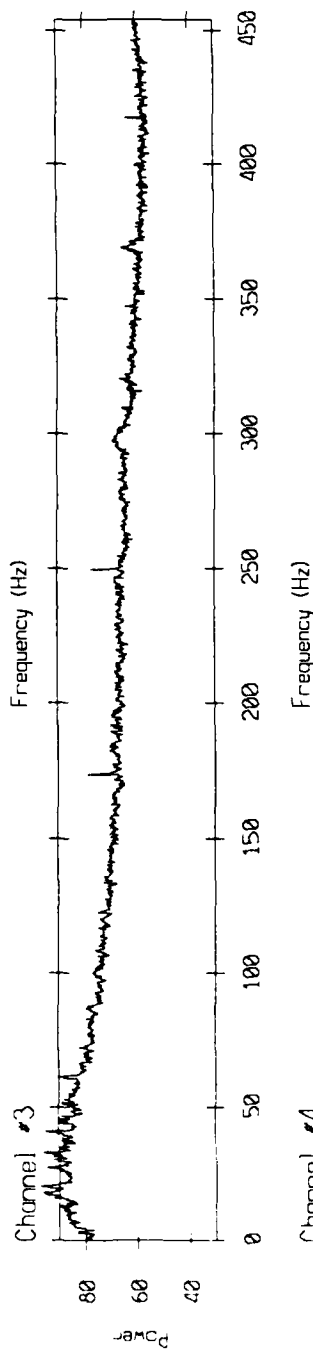
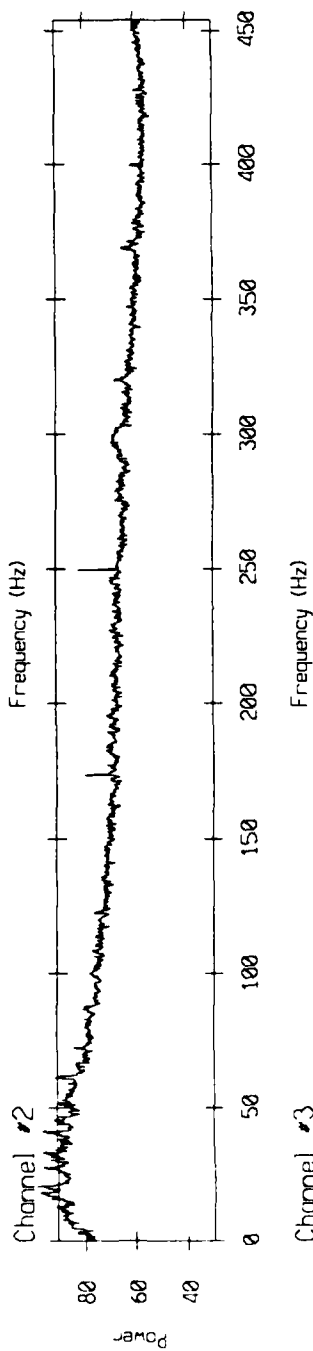
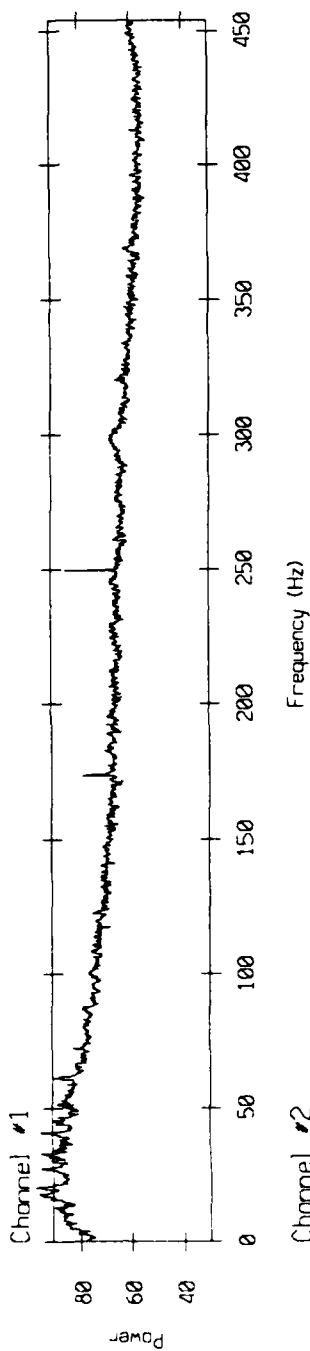


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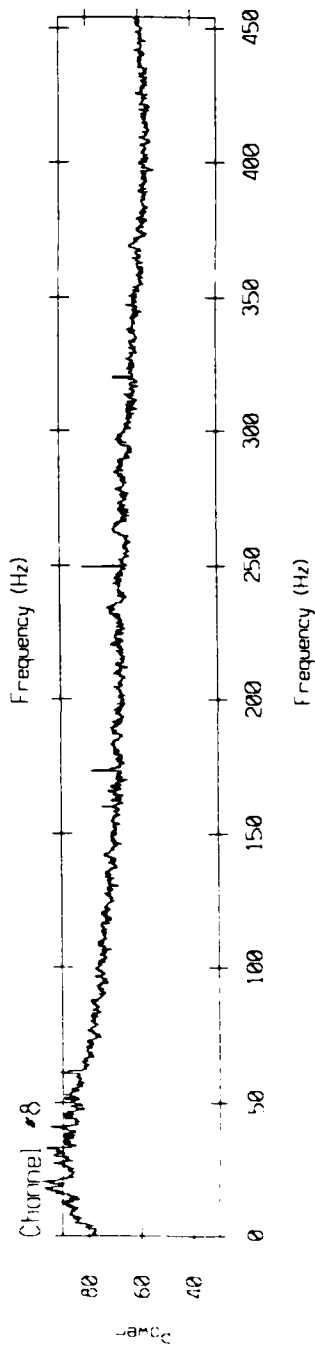
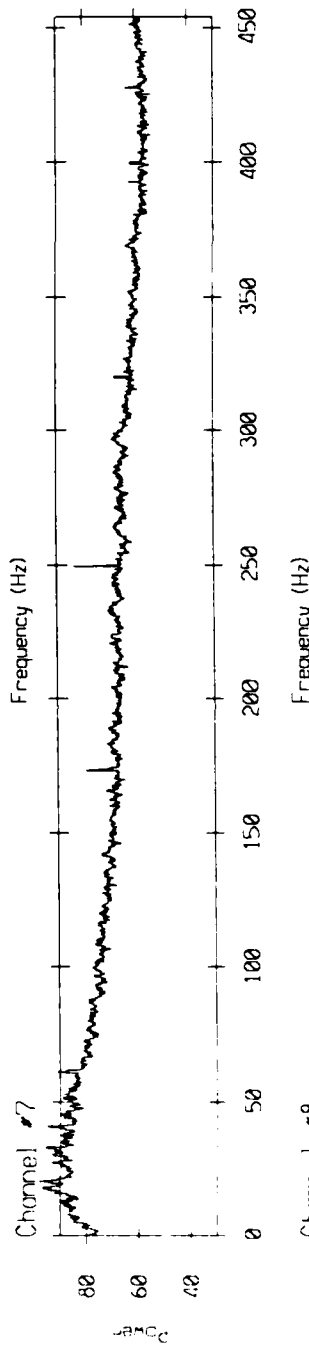
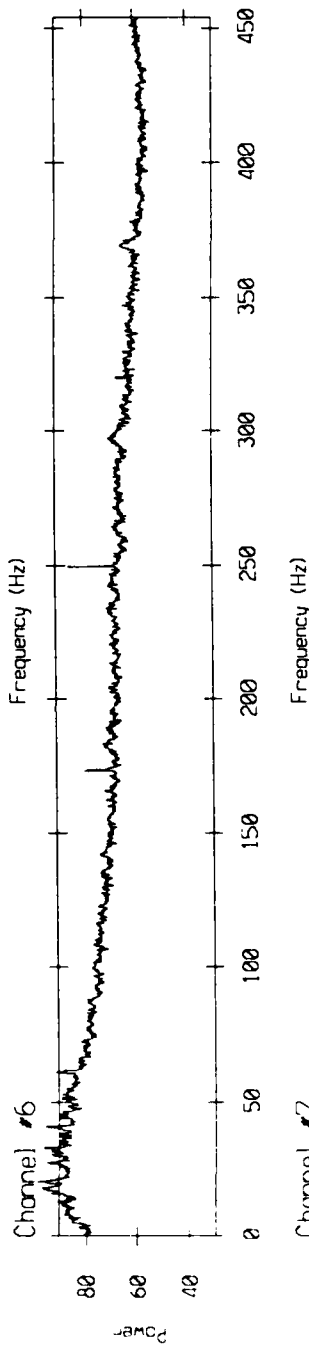
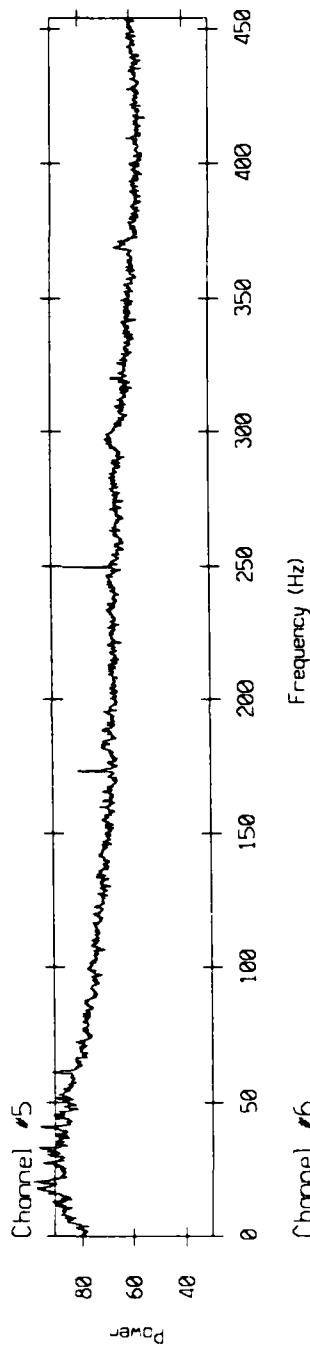
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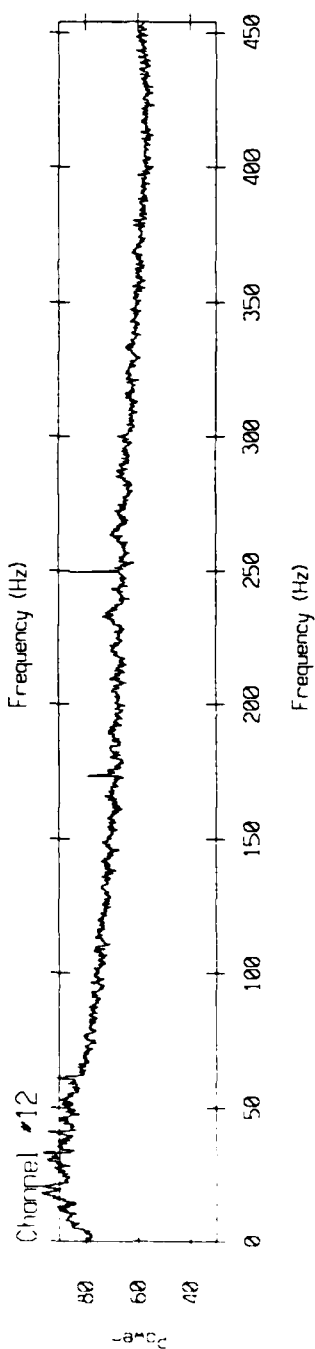
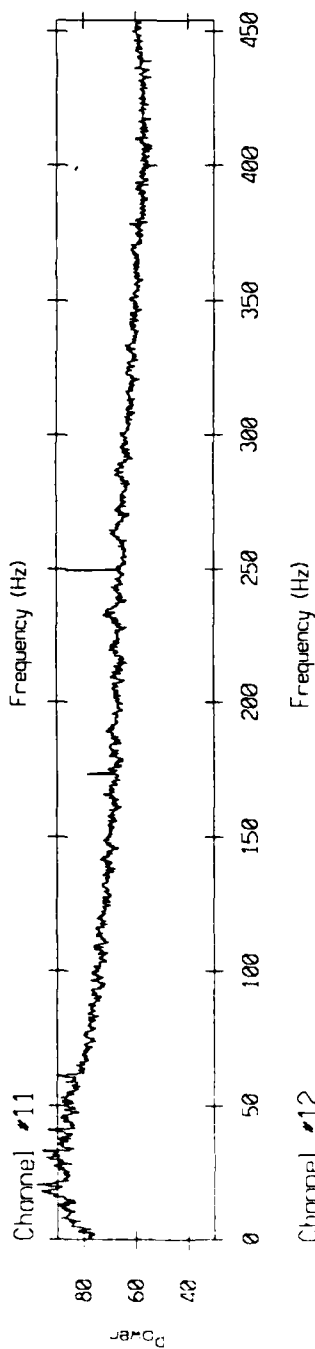
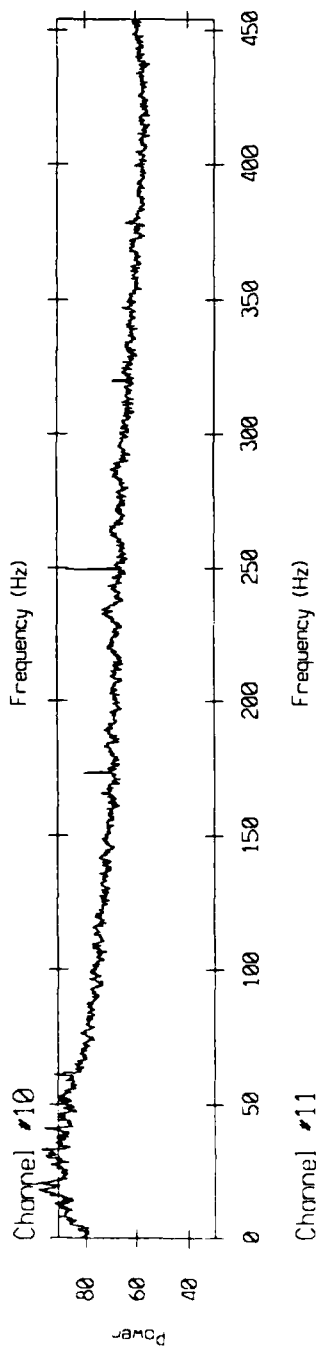
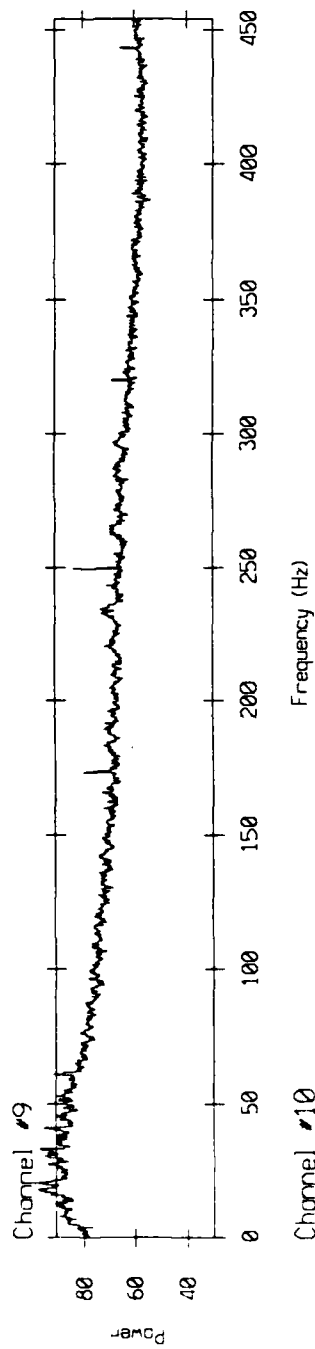
Power Spectrum - 85010.1



Power Spectrum - 85010.1

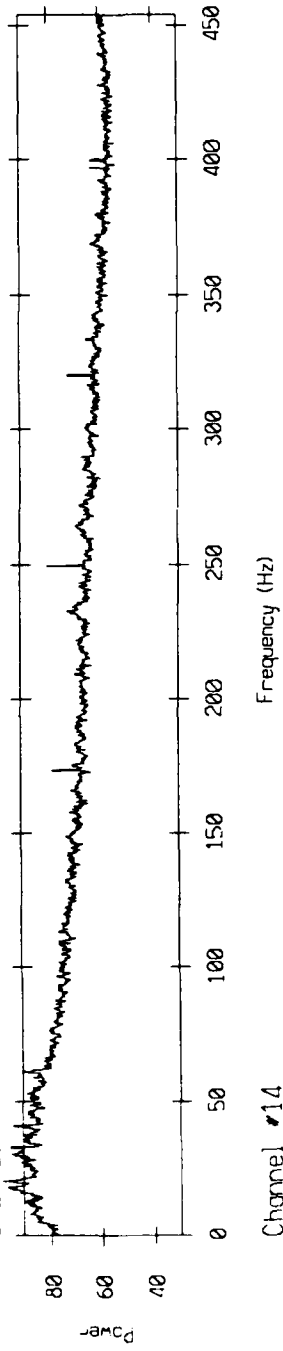


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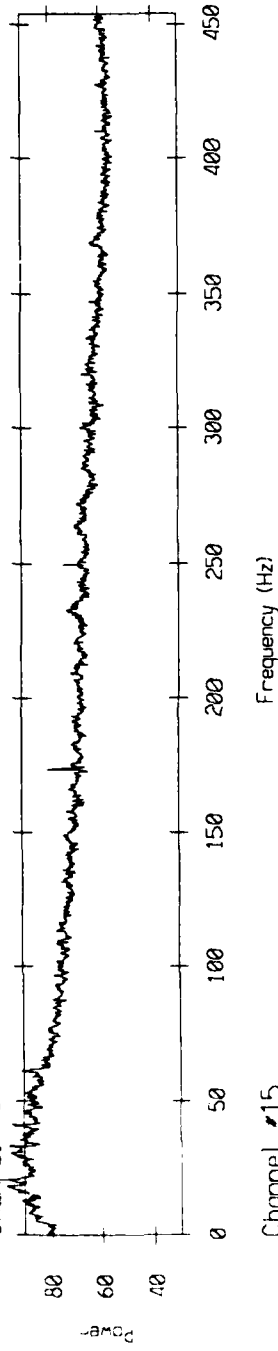


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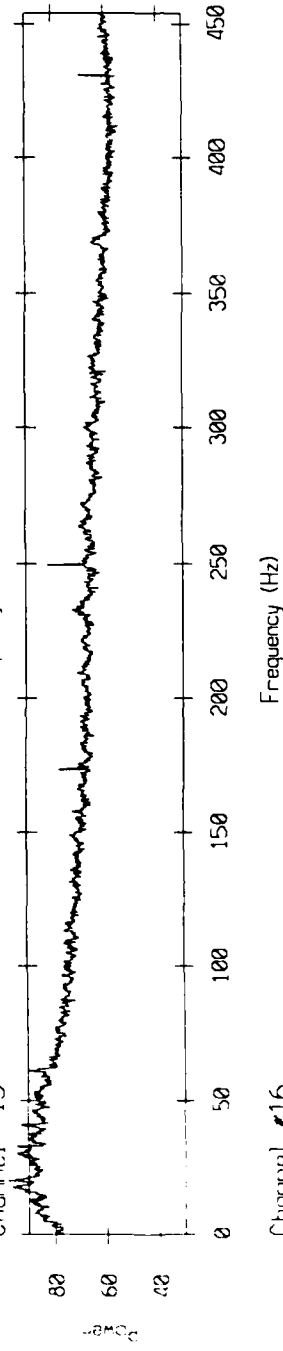
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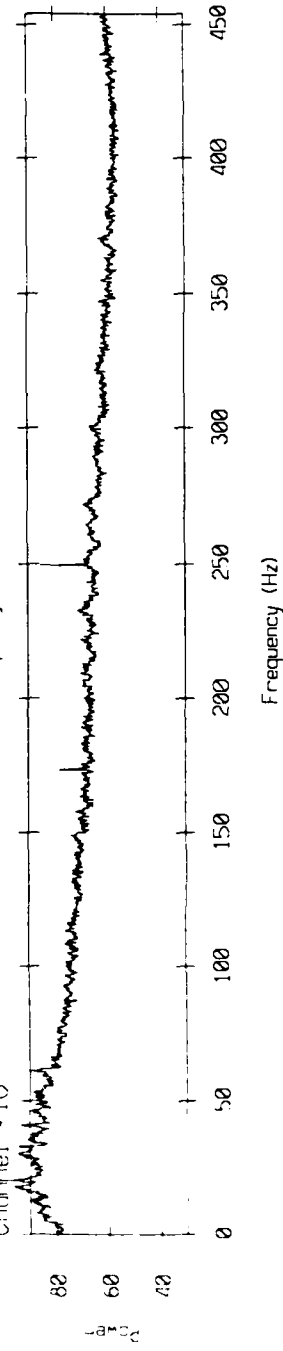
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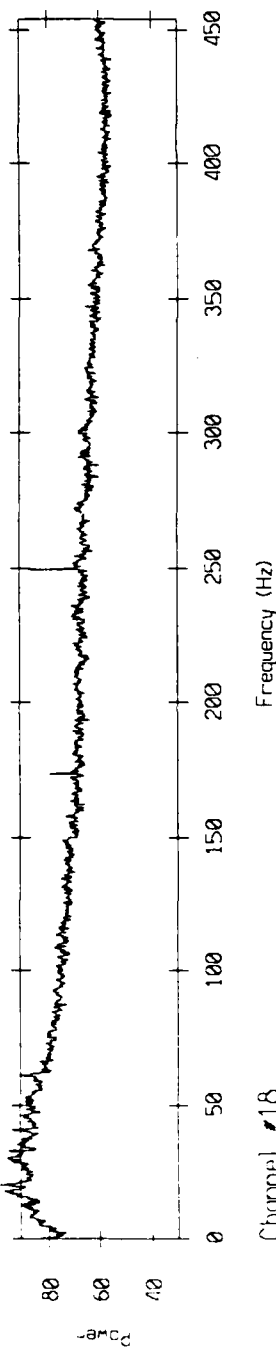
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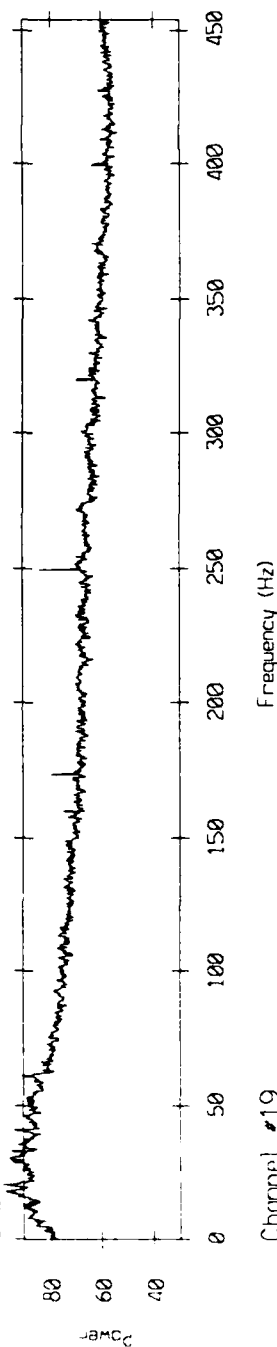


Power Spectrum - 85010.1

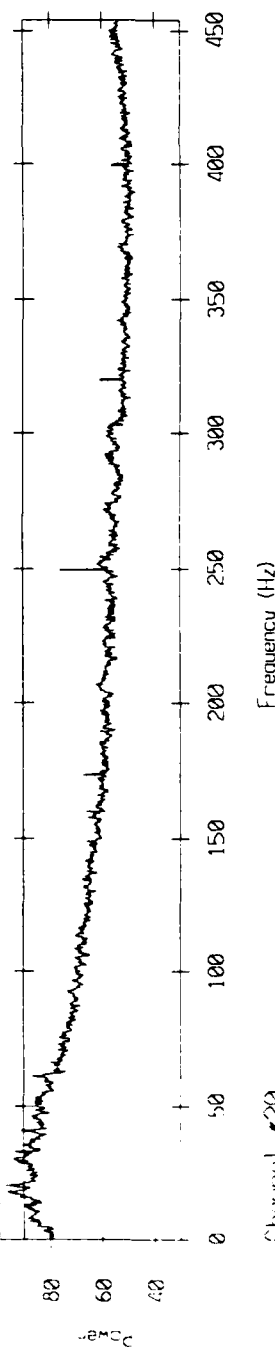
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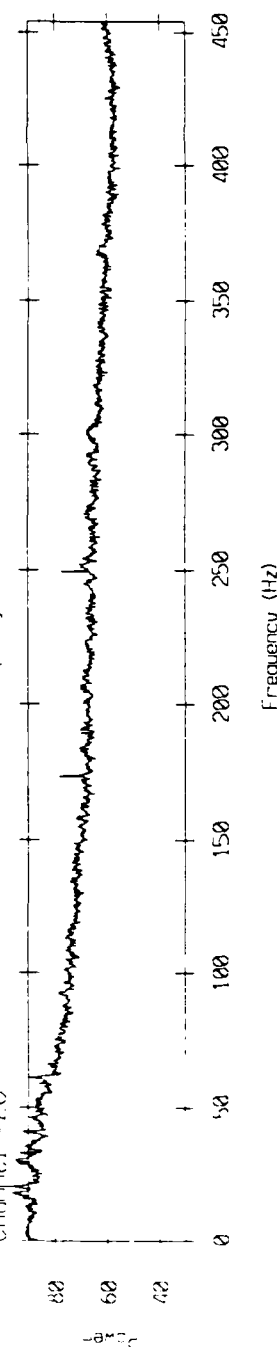
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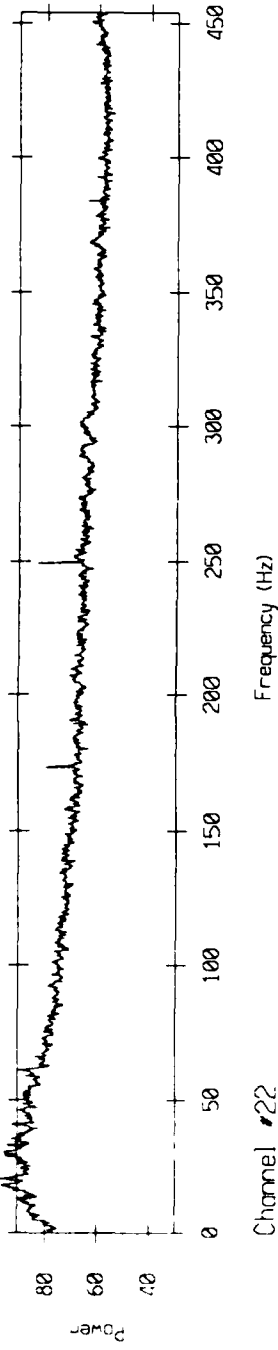


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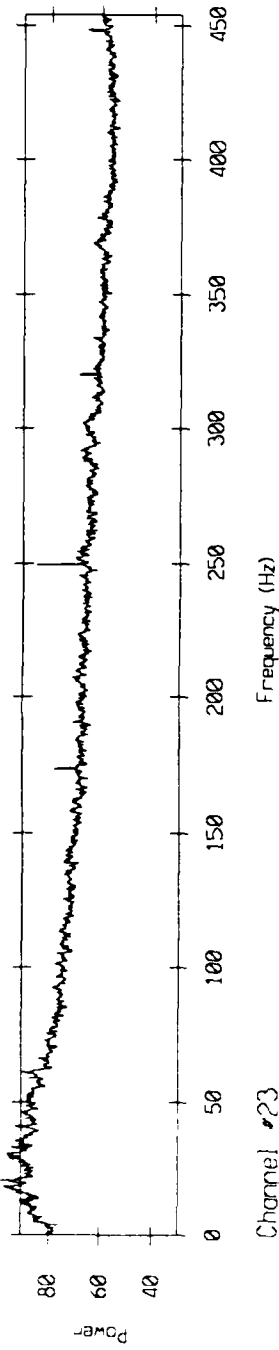


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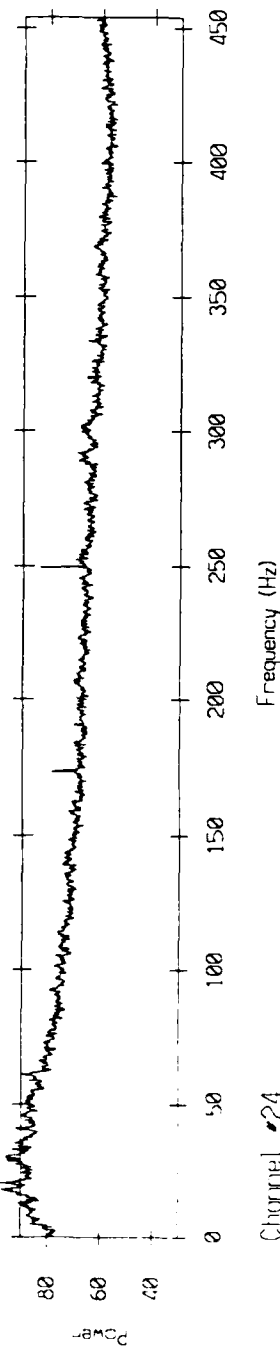
Channel #21



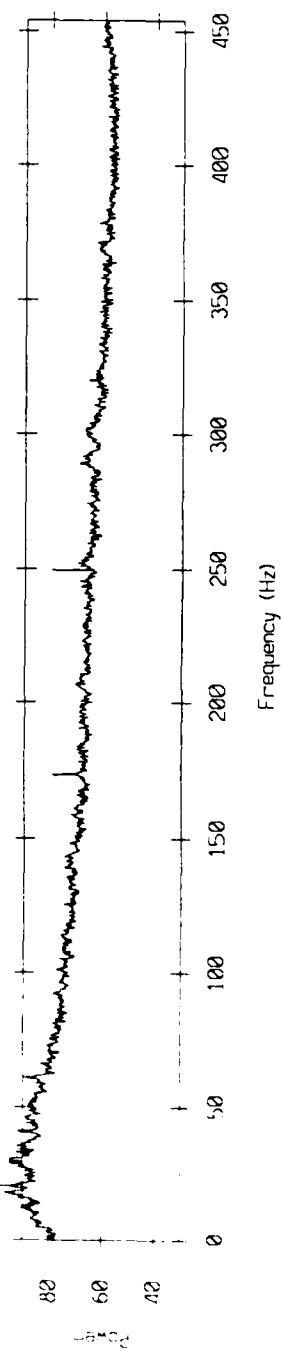
Channel #22



Channel #23

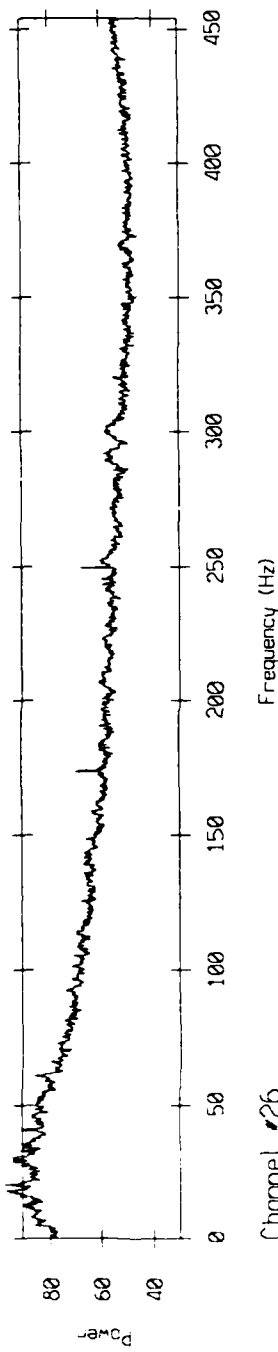


Channel #24

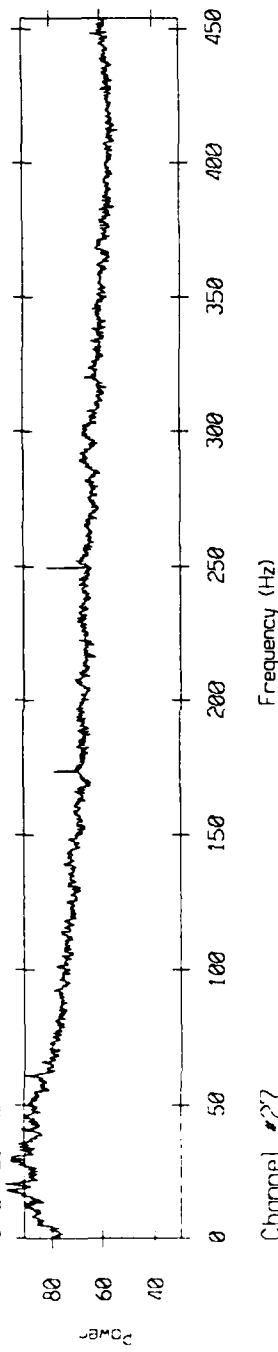


Power Spectrum - 85010.1

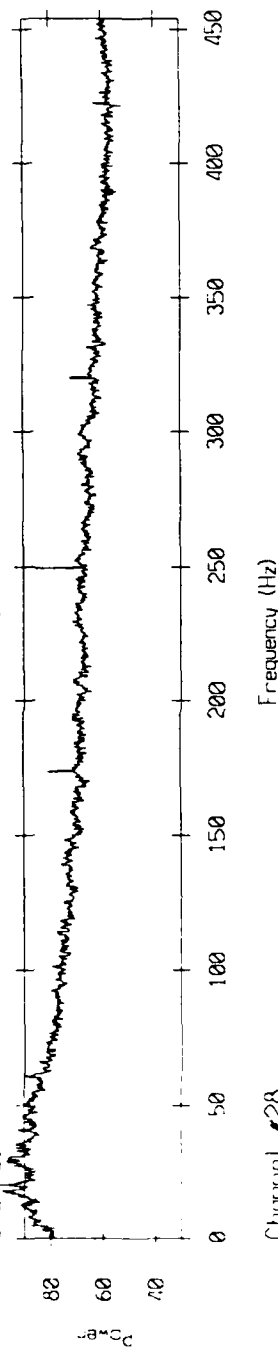
Channel #25



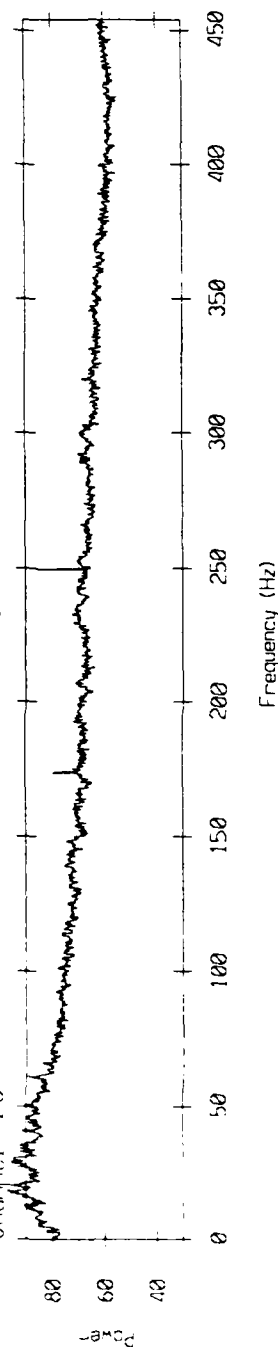
Channel #26



Channel #27

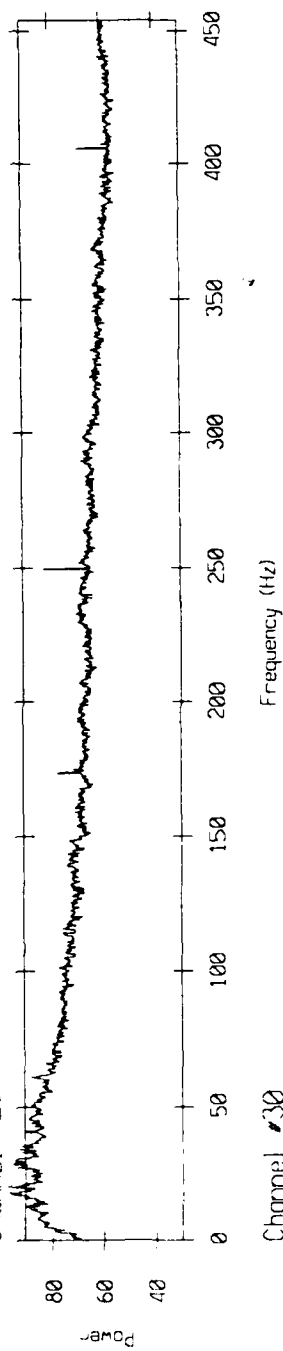


Channel #28

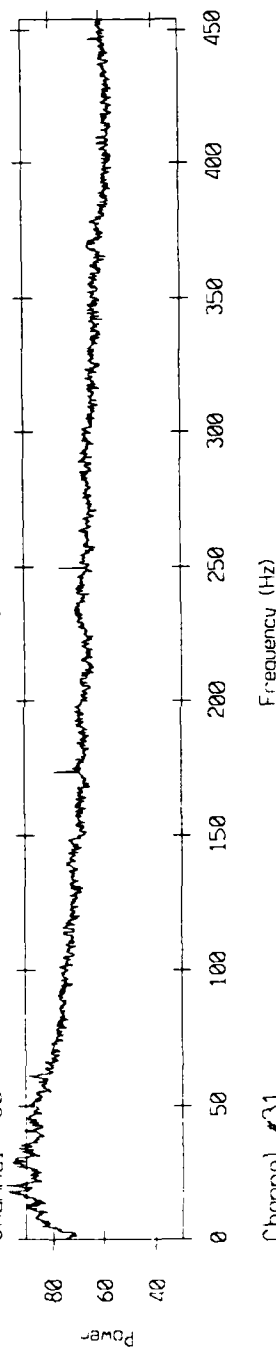


Power Spectrum - 85010.1

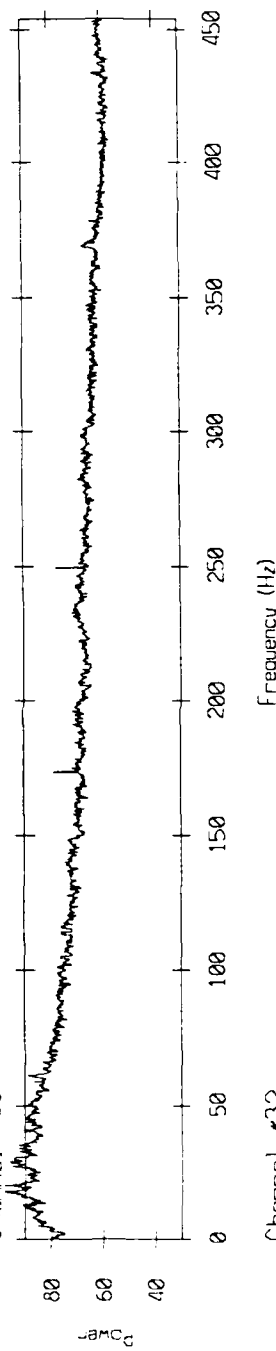
Channel #29



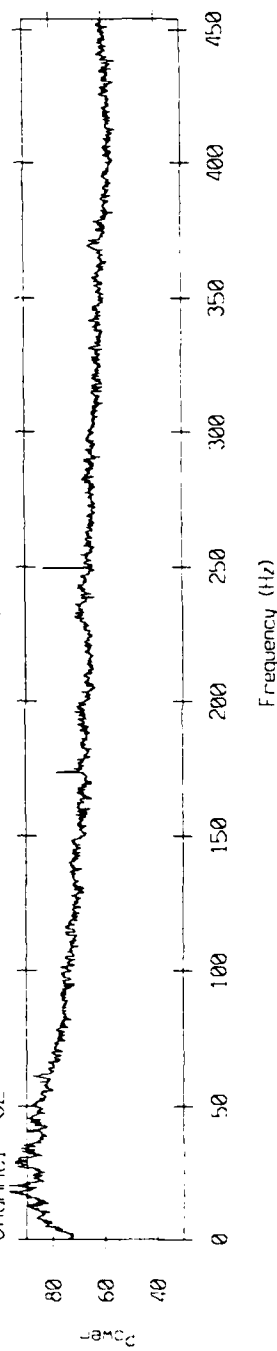
Channel #30



Channel #31

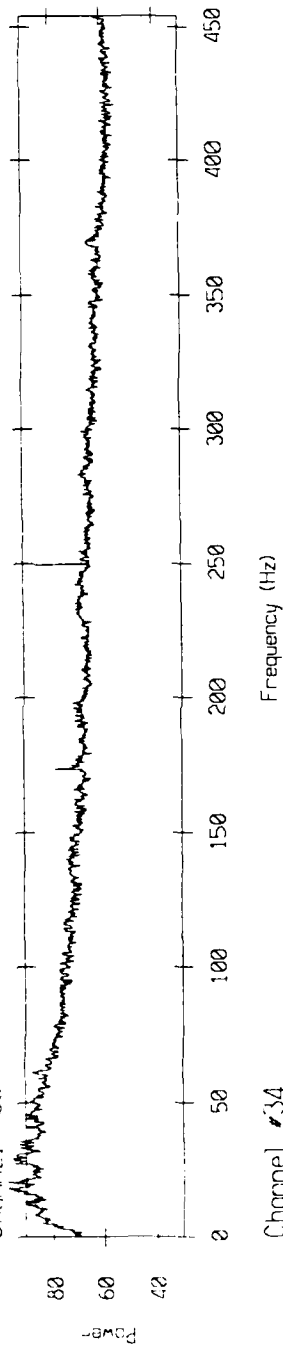


Channel #32

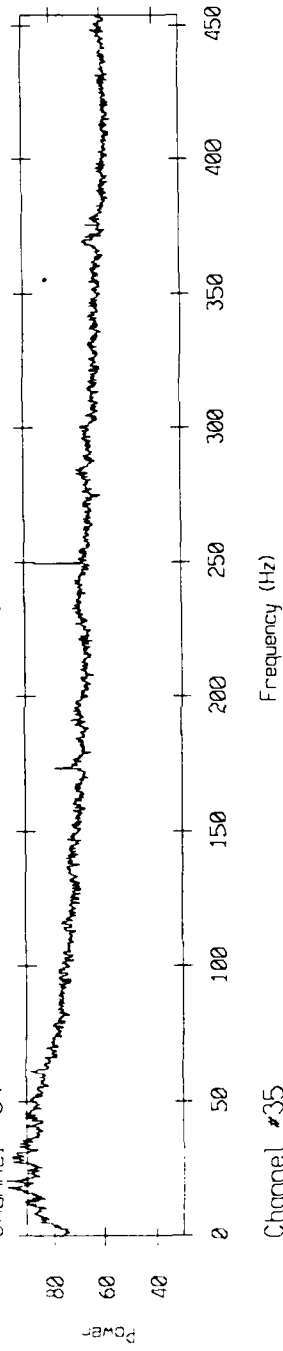


Power Spectrum - 85010.1

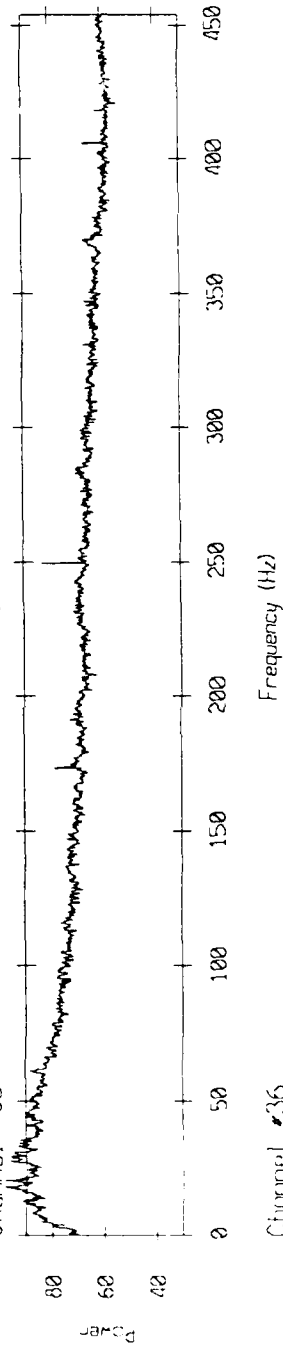
Channel #33



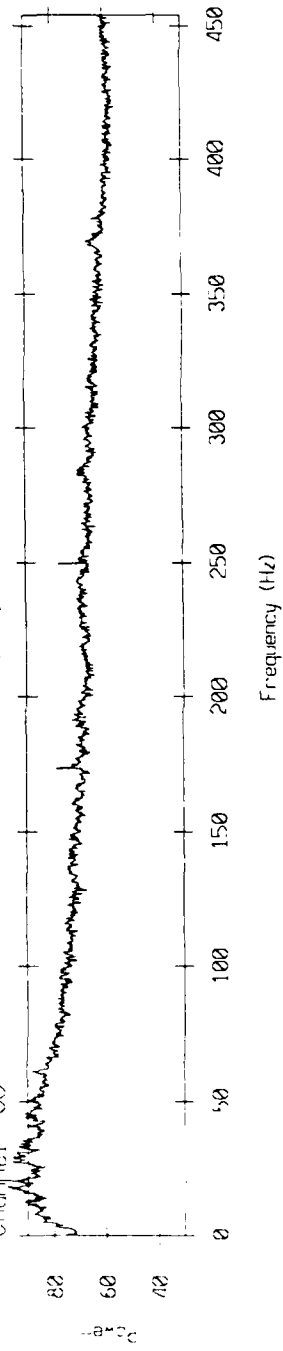
Channel #34



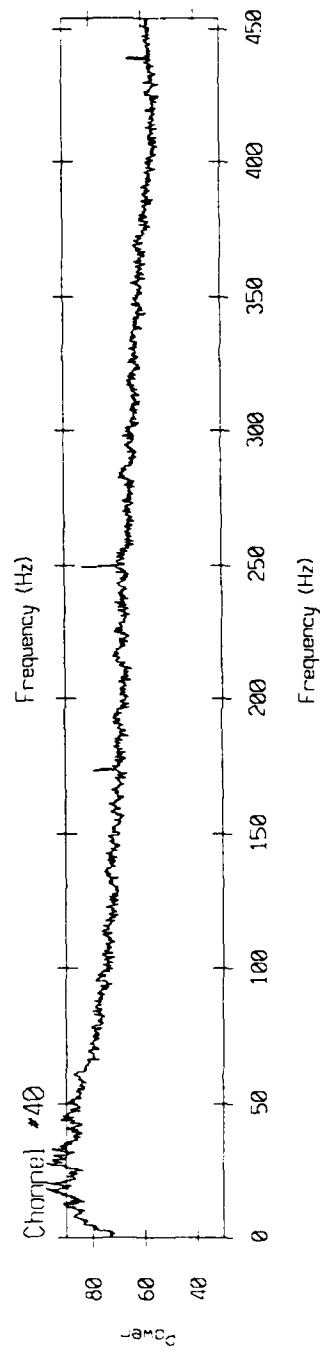
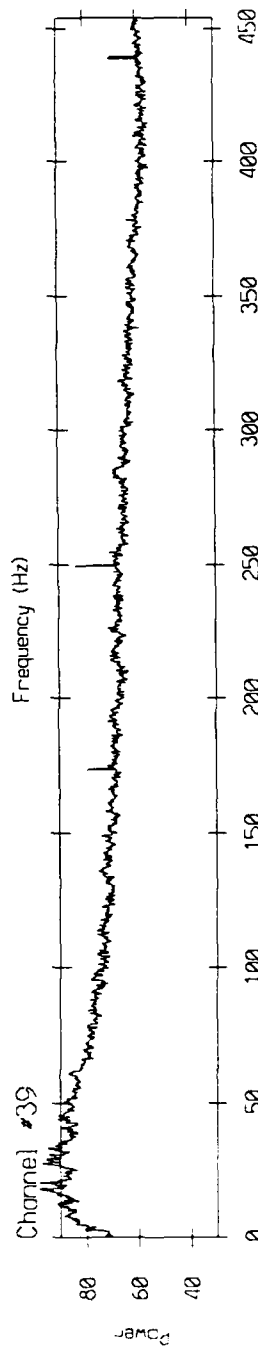
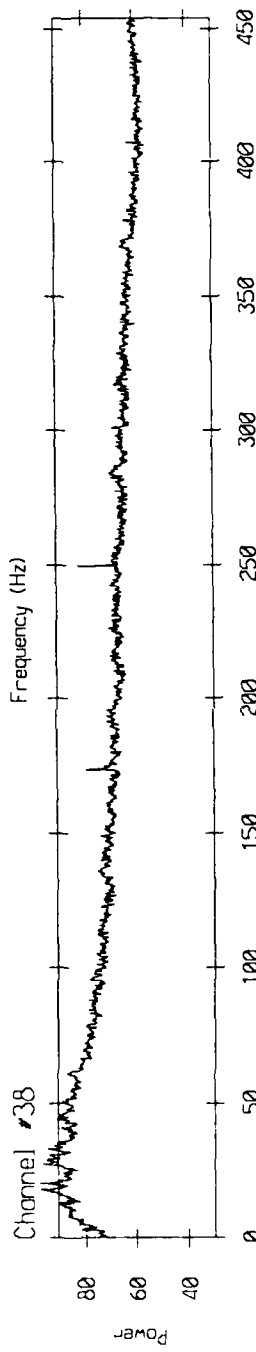
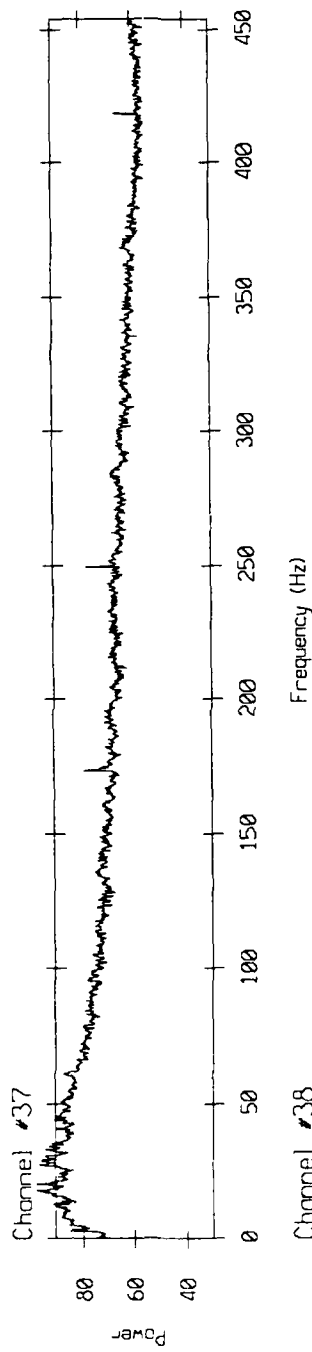
Channel #35



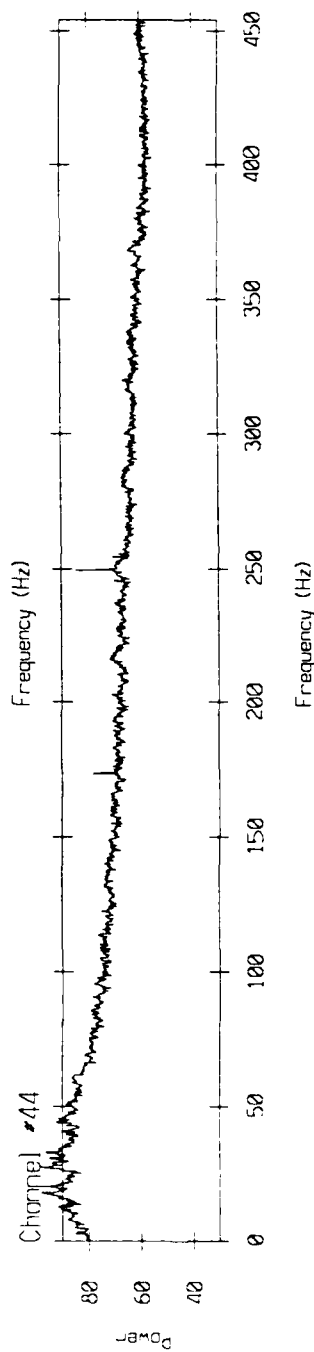
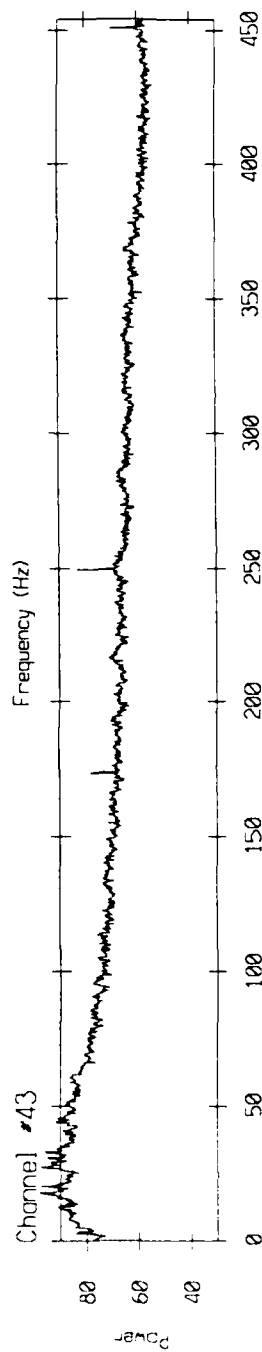
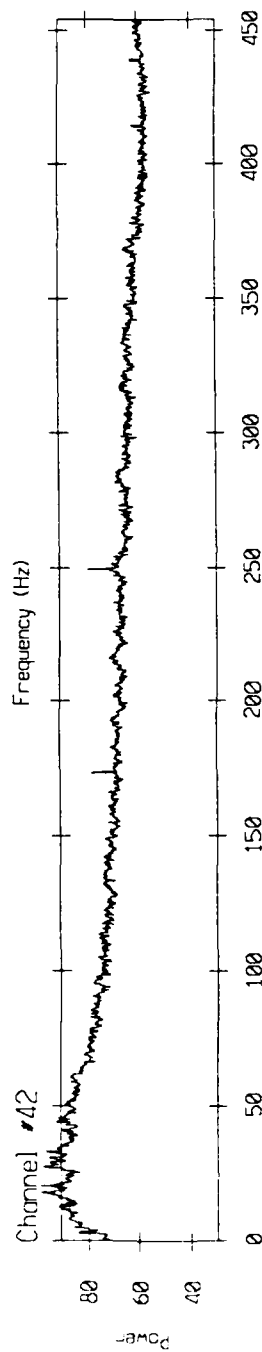
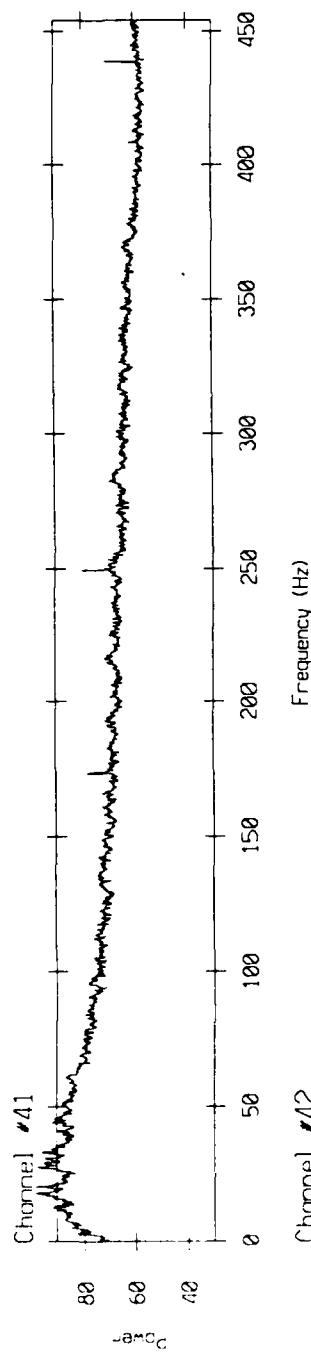
Channel #36



Power Spectrum - 85010.1

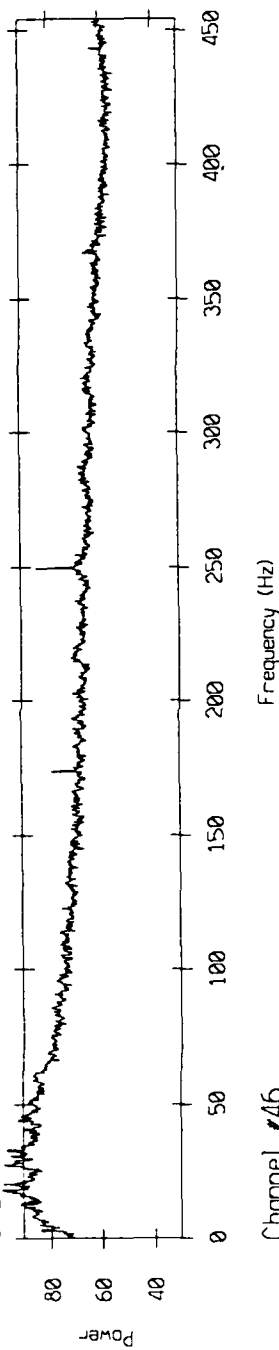


Power Spectrum - 85010.1

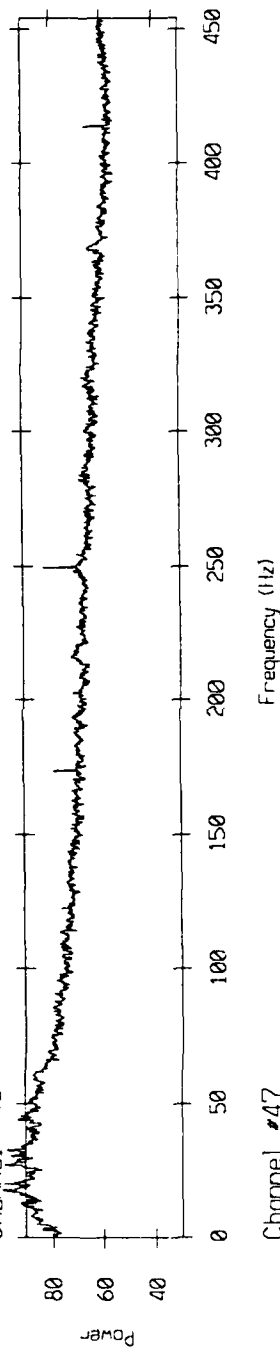


Power Spectrum - 85010.1

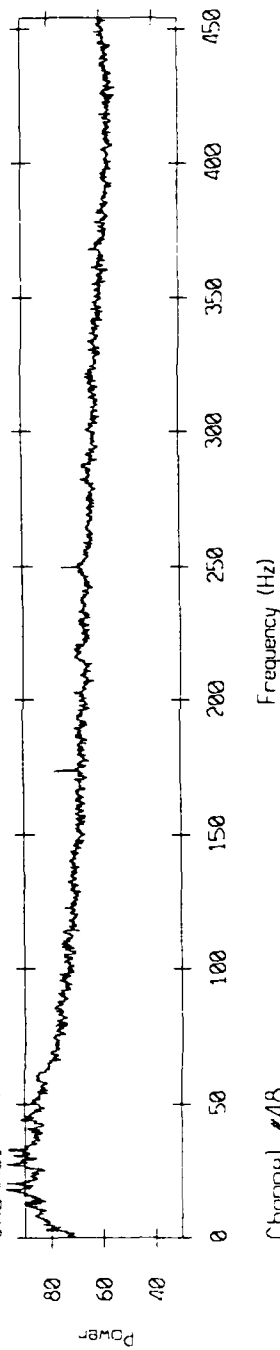
Channel #45



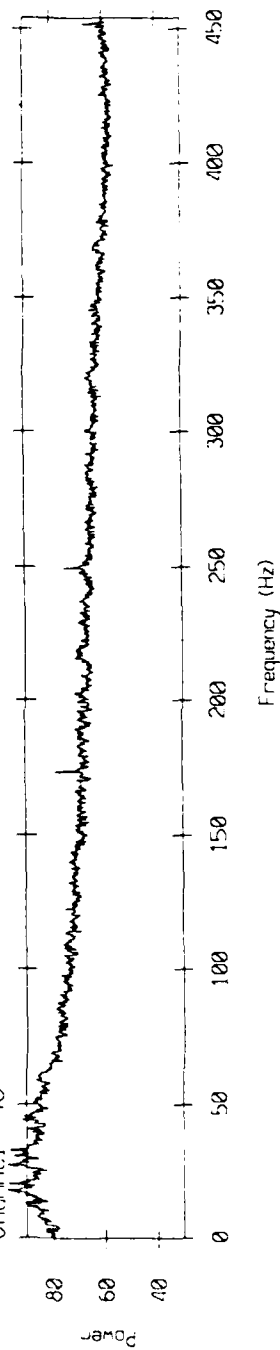
Channel #46



Channel #47



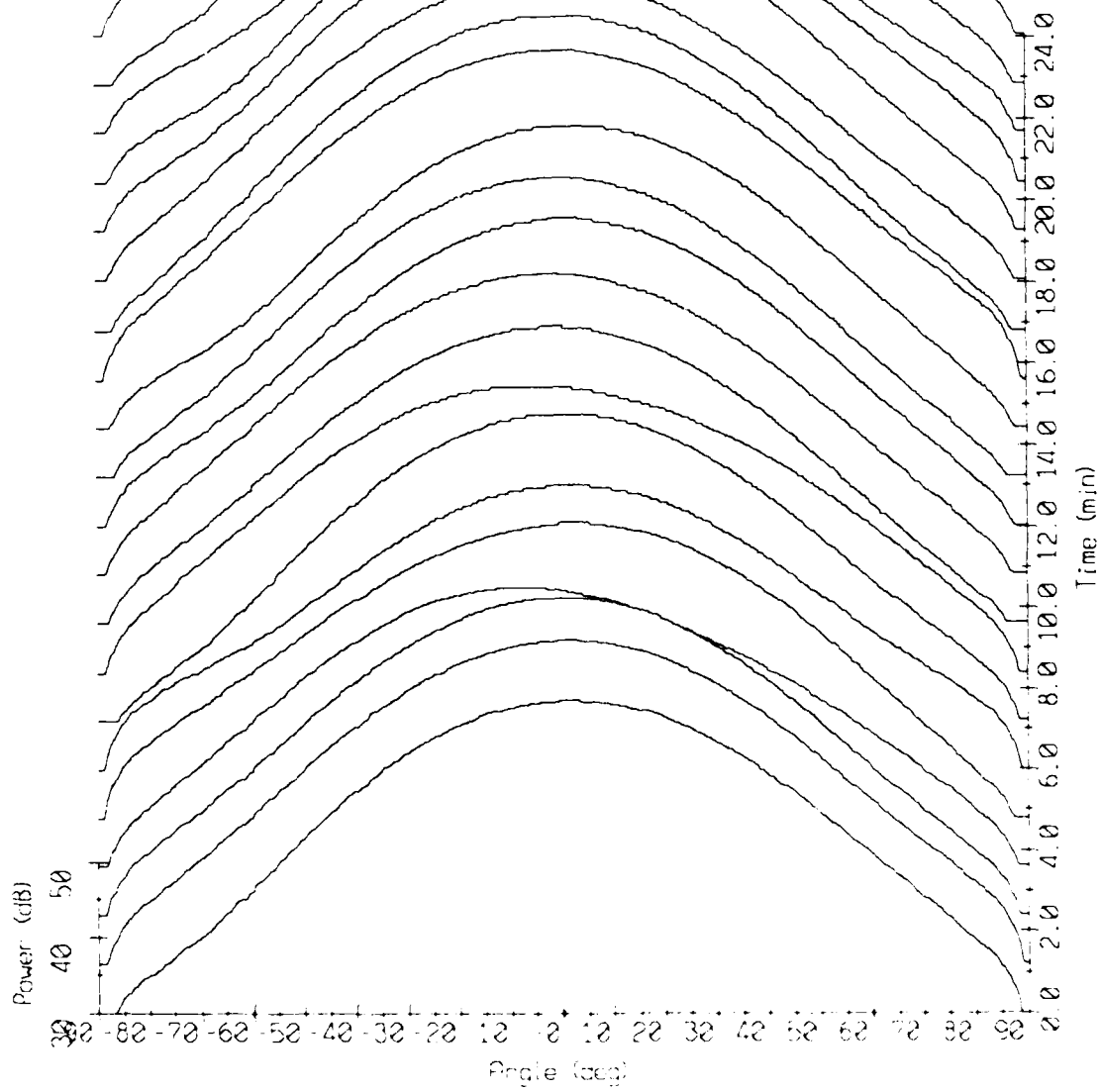
Channel #48



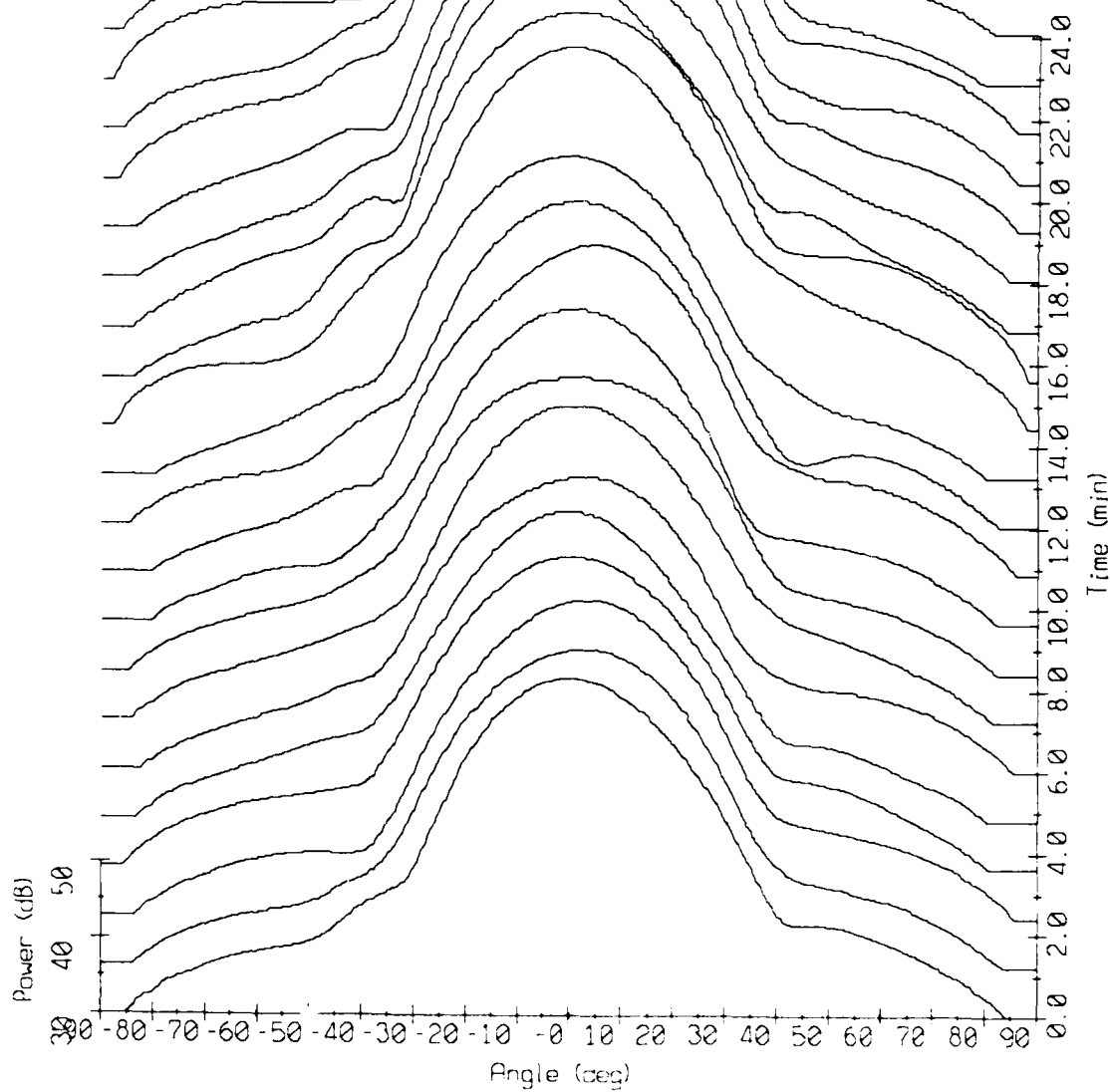


#### IV. Array Response: Waterfall, KB Window.

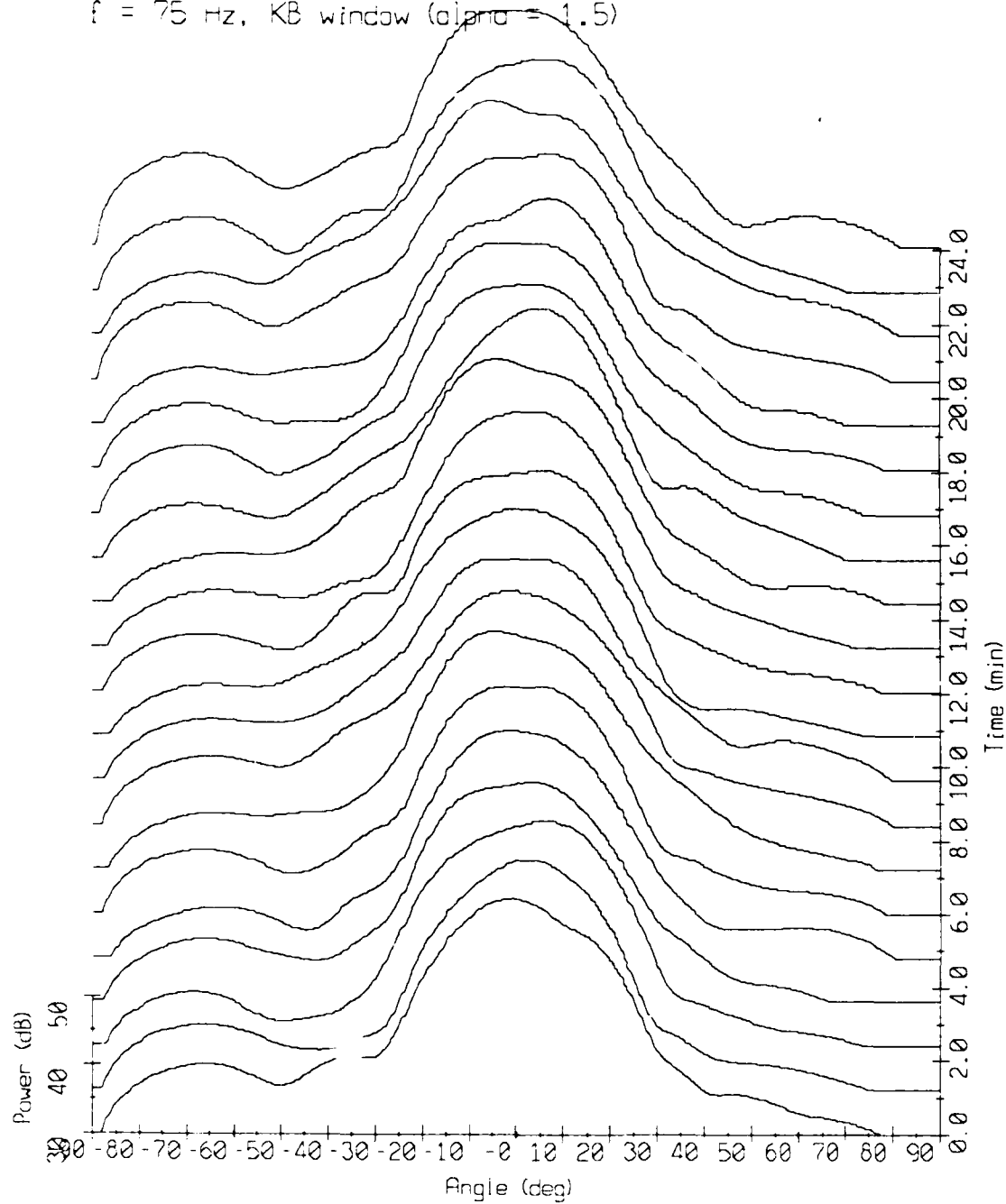
Array Response - 85010 Bin #4323  
 $f = 25$  Hz, KB window (c/pno = 1.5)



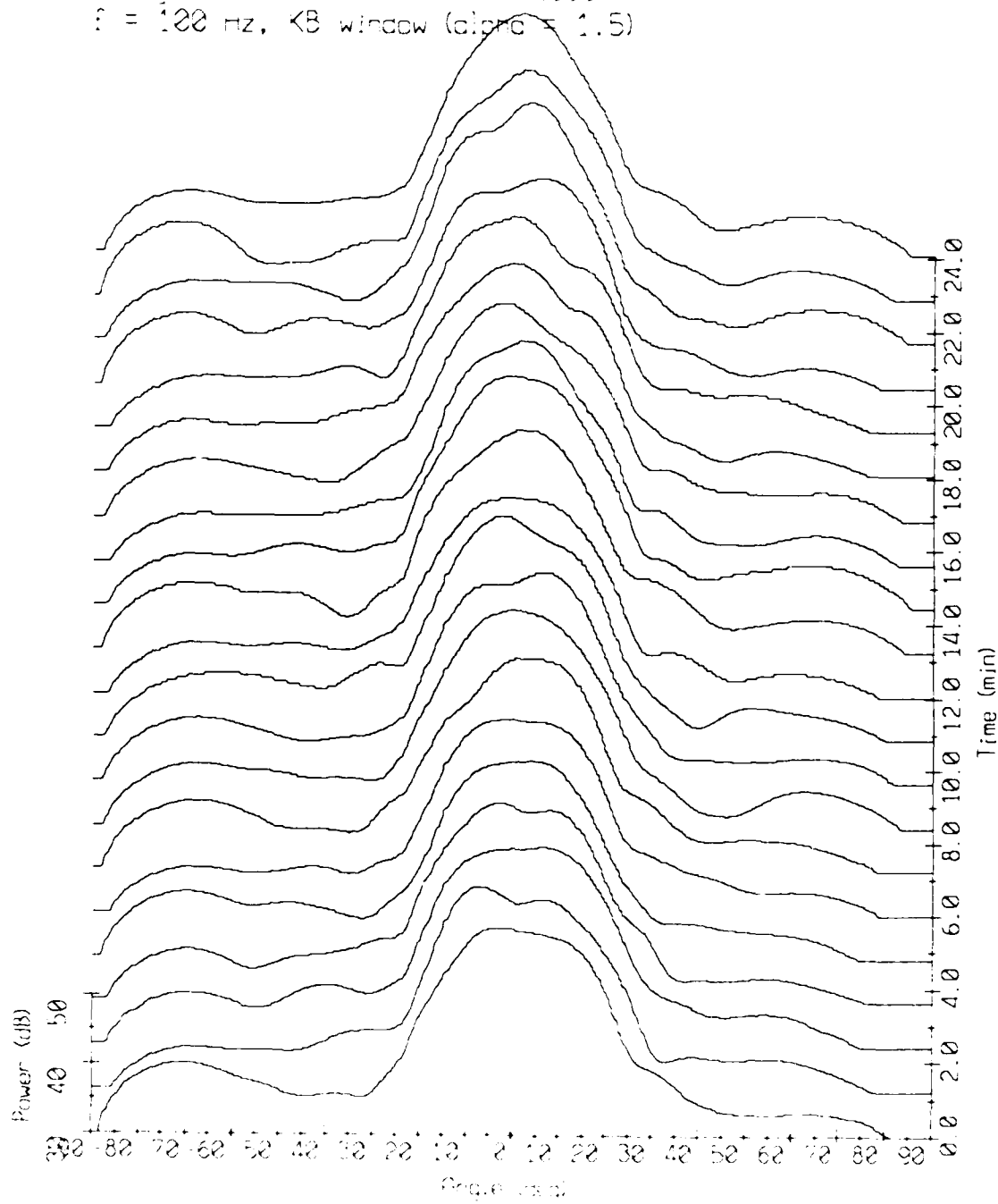
Array Response - 85010.8m \*4548  
f = 50 Hz,  $\Delta B$  window (alpha = 1.5)



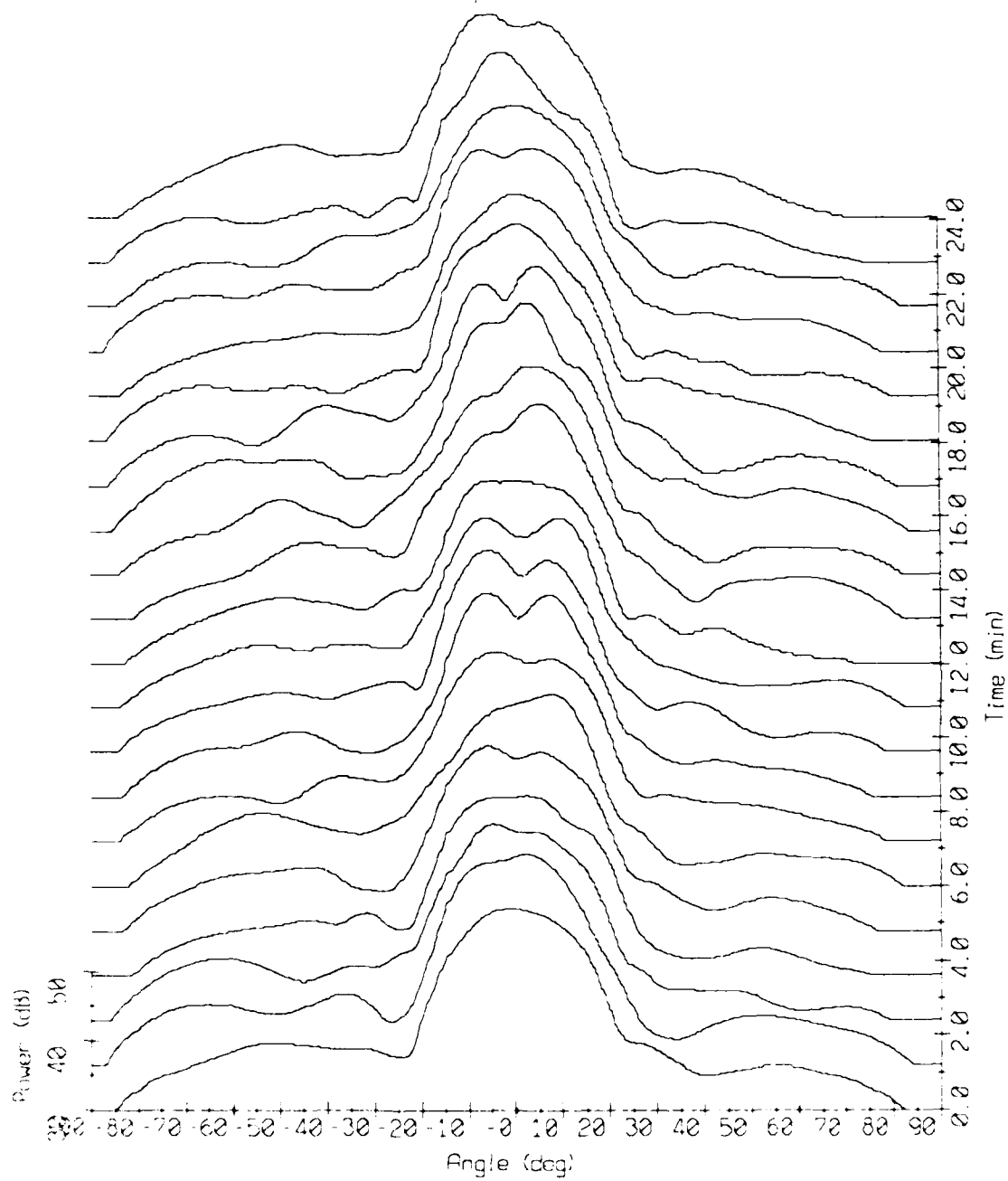
Array Response - 85010 Bin #4774  
 $f = 75$  Hz, KB window ( $\alpha_{\text{band}} = 1.5$ )



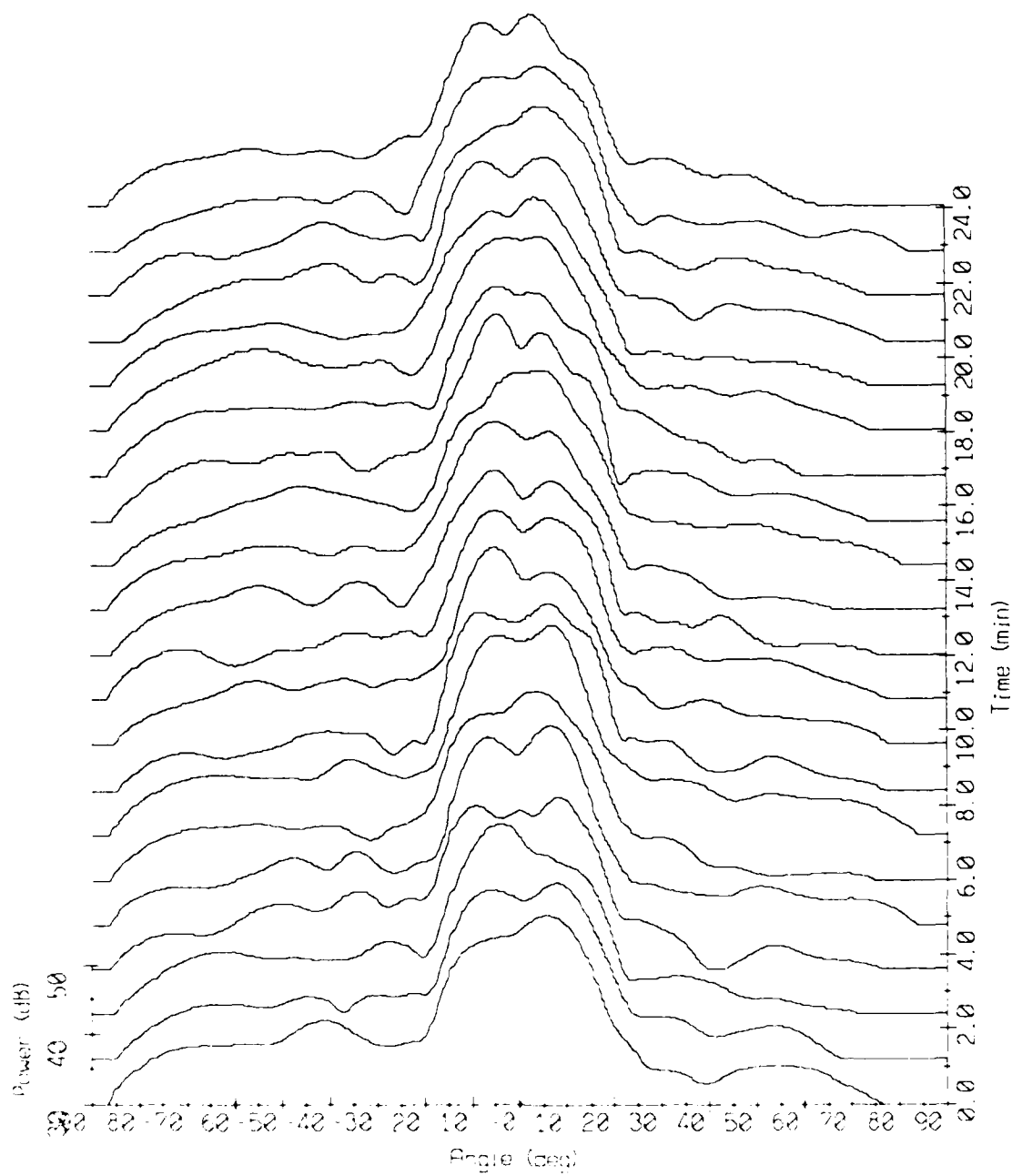
Array Response - 85010 Bin #4999  
 $f = 100$  Hz,  $\Delta B$  window (align = 1.5)



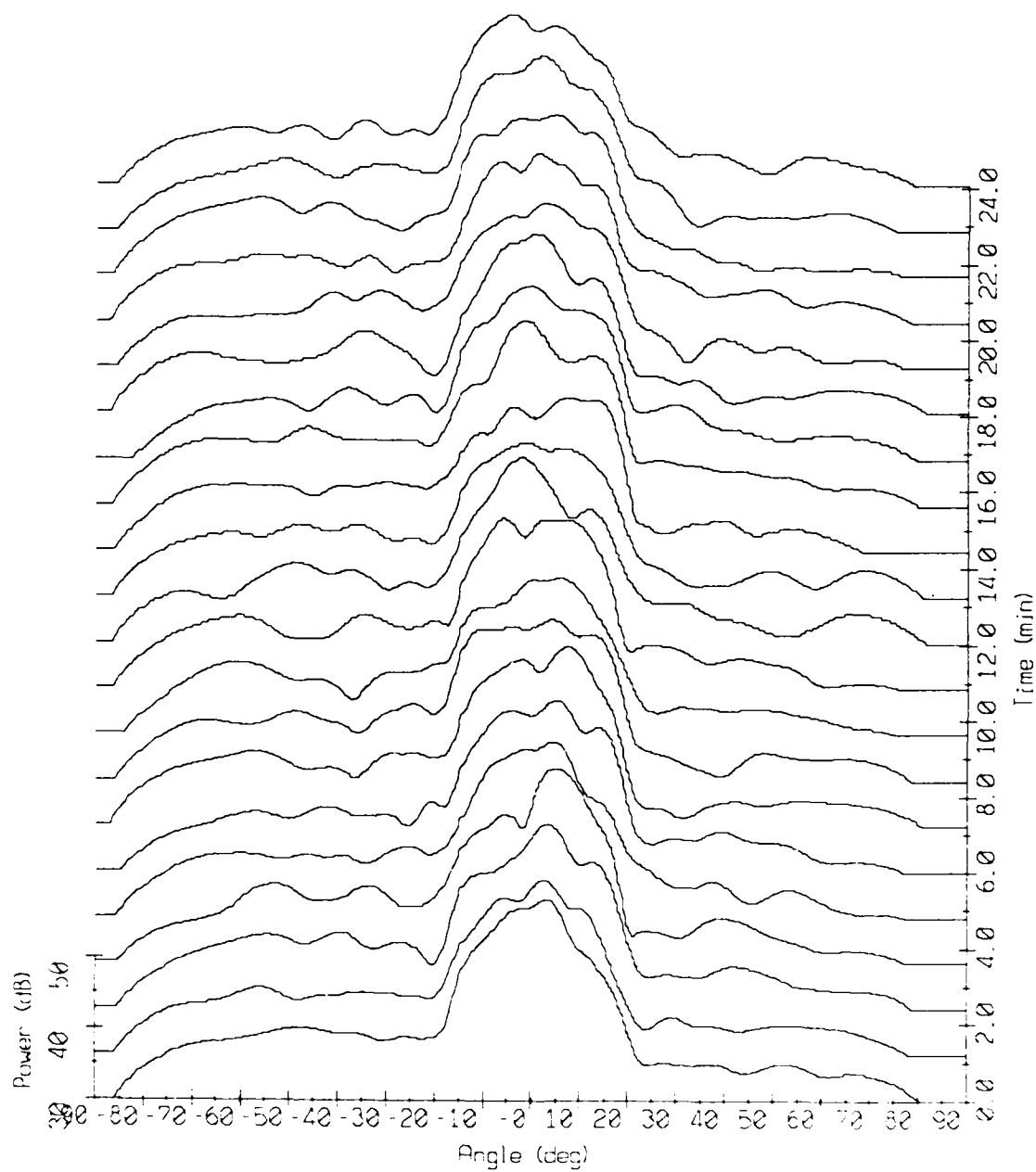
Array Response - 85010 Bin #5225  
 $f = 125$  Hz, KB window ( $\alpha = 1.5$ )



Array Response - 85010 Bin #5451  
 $f = 150$  Hz,  $\Delta B$  window ( $\alpha = 1.5$ )

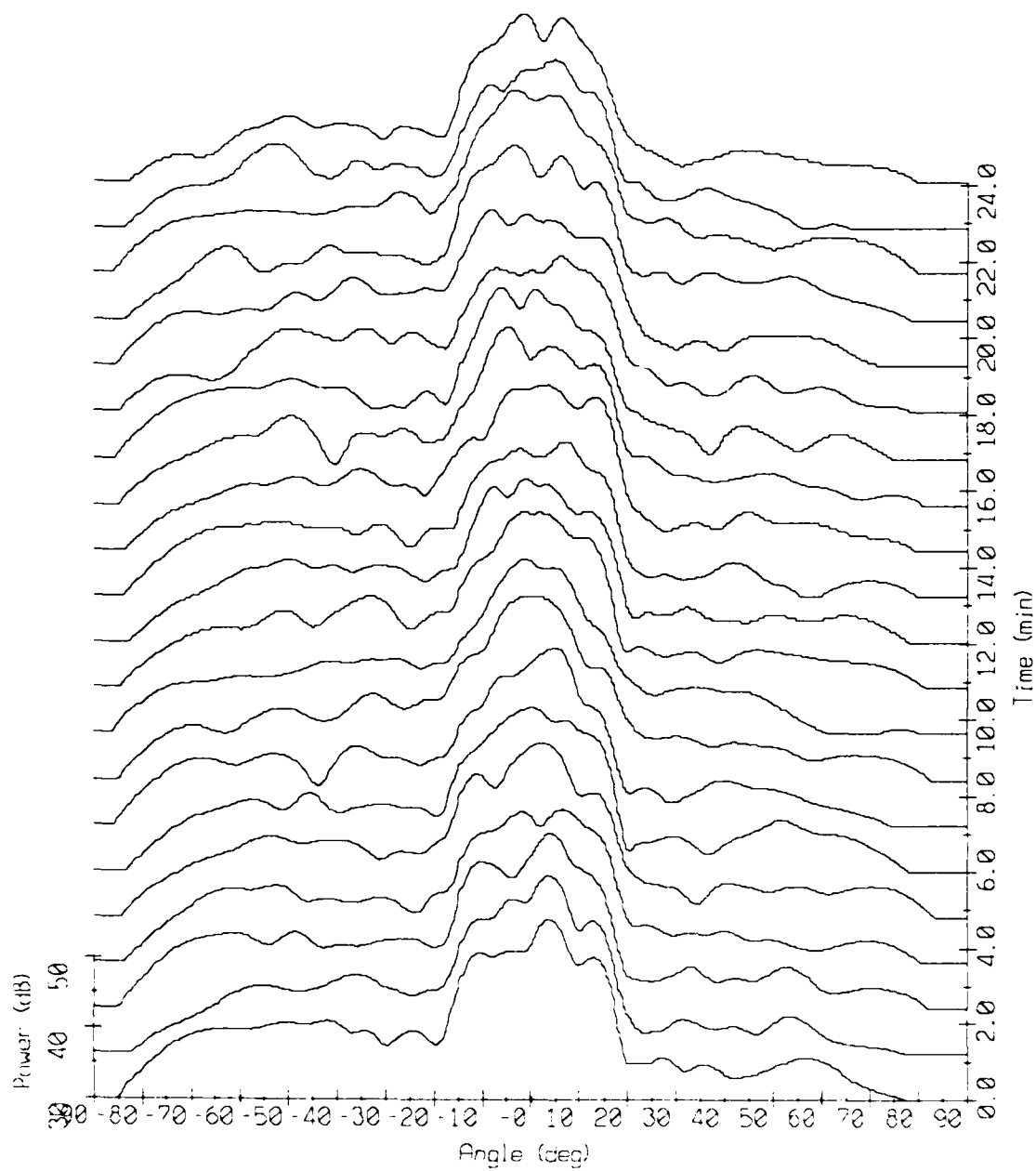


Array Response - 85010 Bin #5676  
 $f = 175$  Hz, KB window ( $\alpha = 1.5$ )

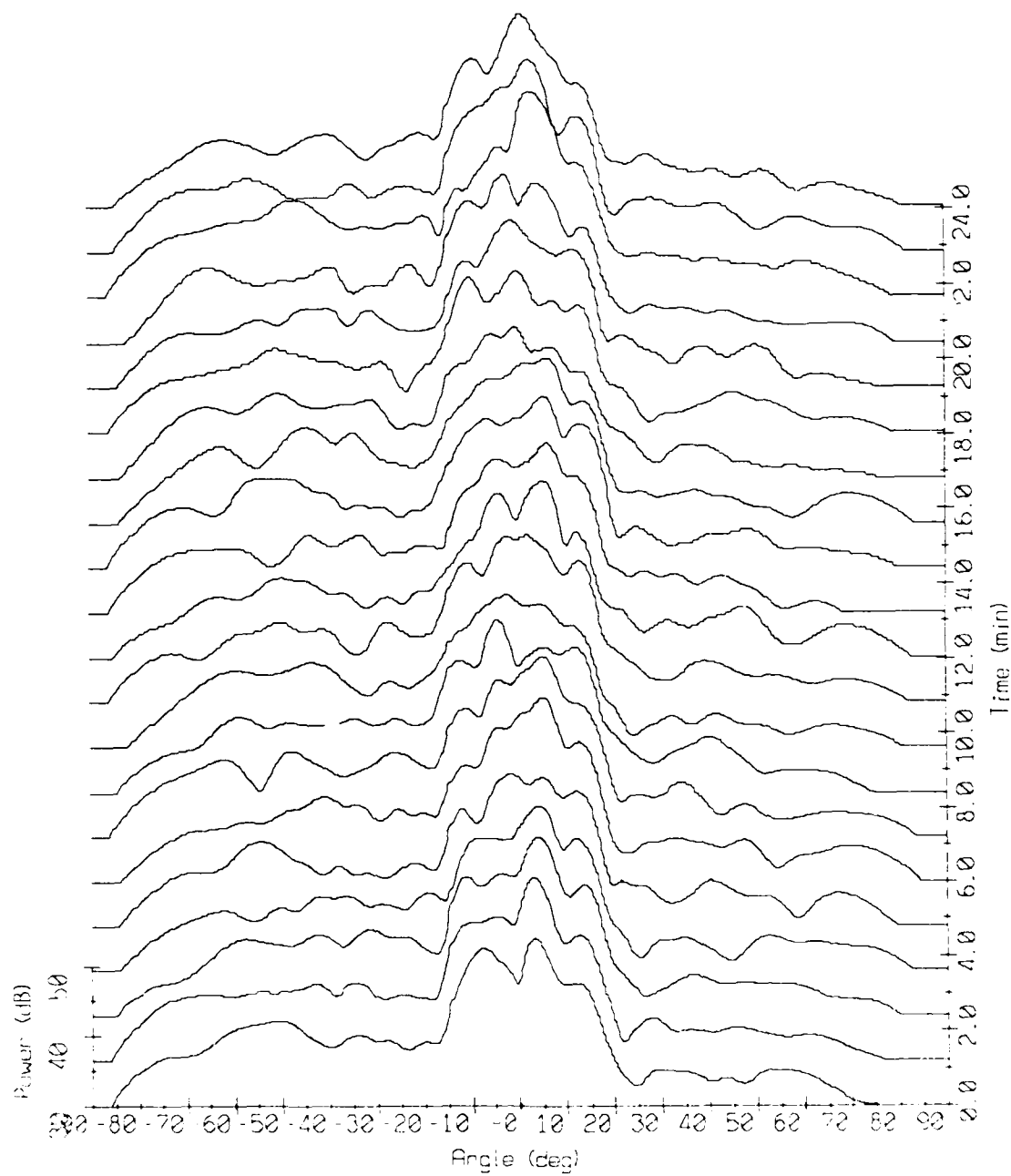




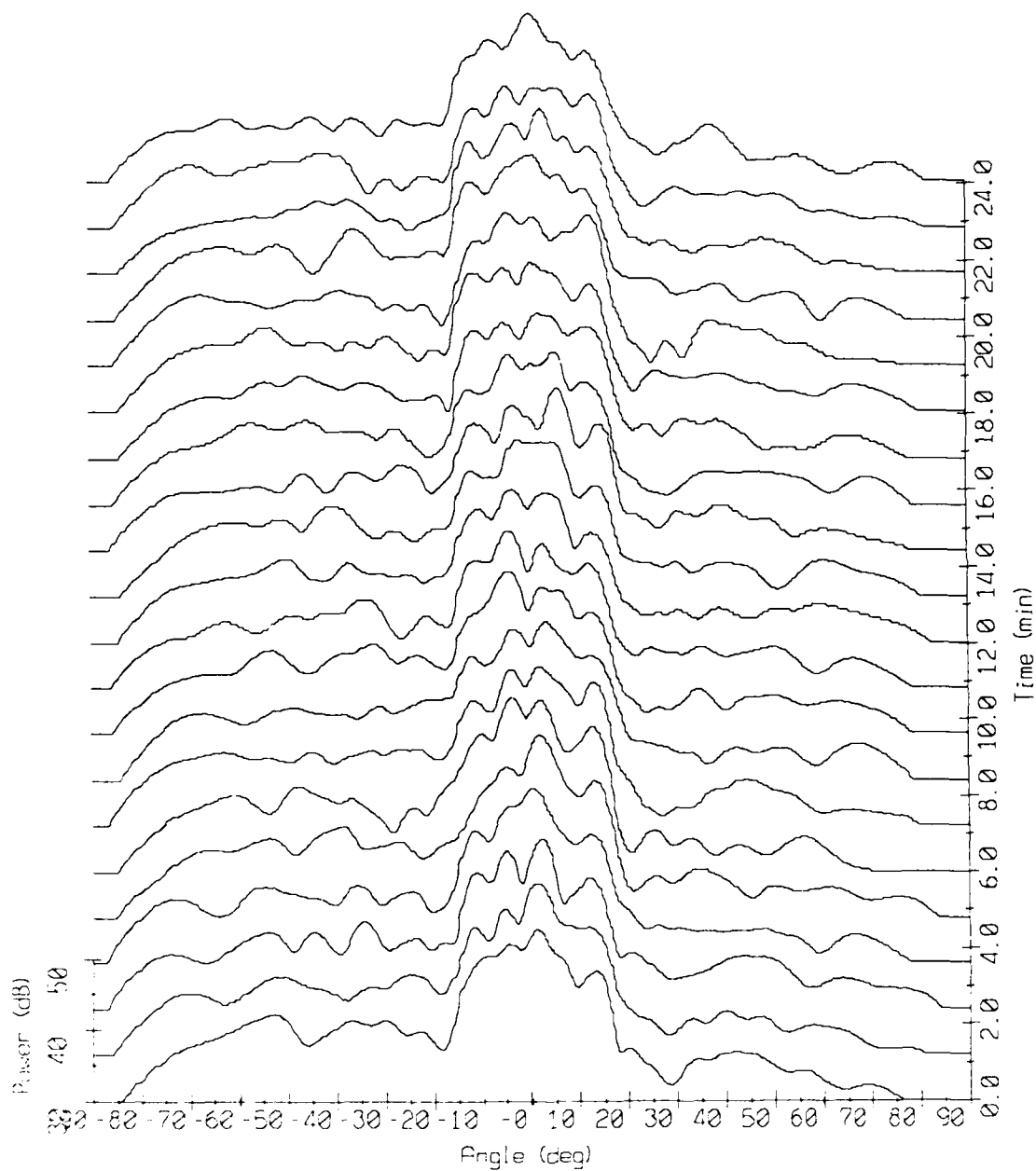
Array Response - 85010 Bin #5902  
 $f = 200$  Hz, KB window ( $\alpha = 1.5$ )



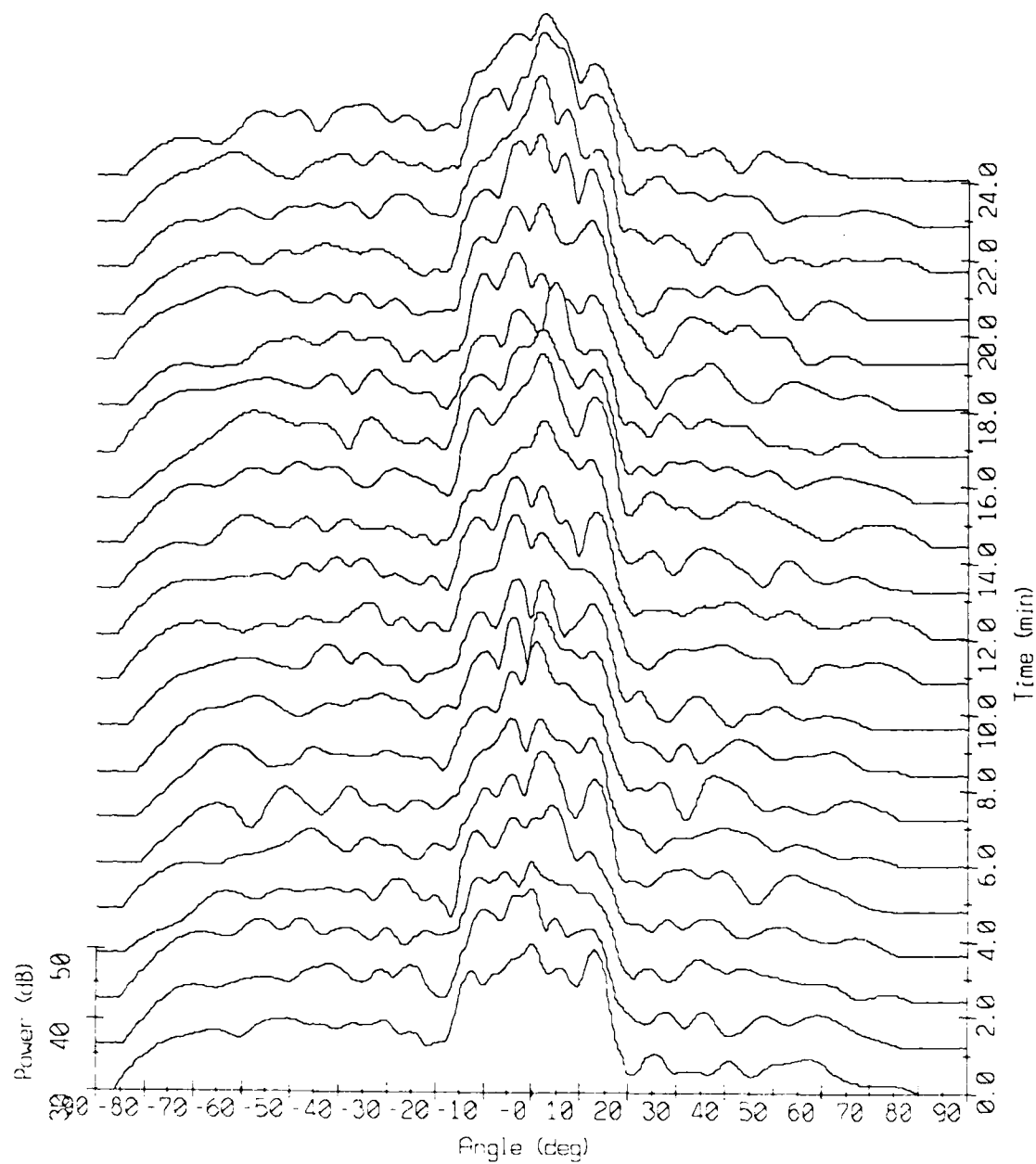
Array Response - 85010 Bin #6127  
 $f = 225$  Hz, K3 window ( $\alpha = 1.5$ )



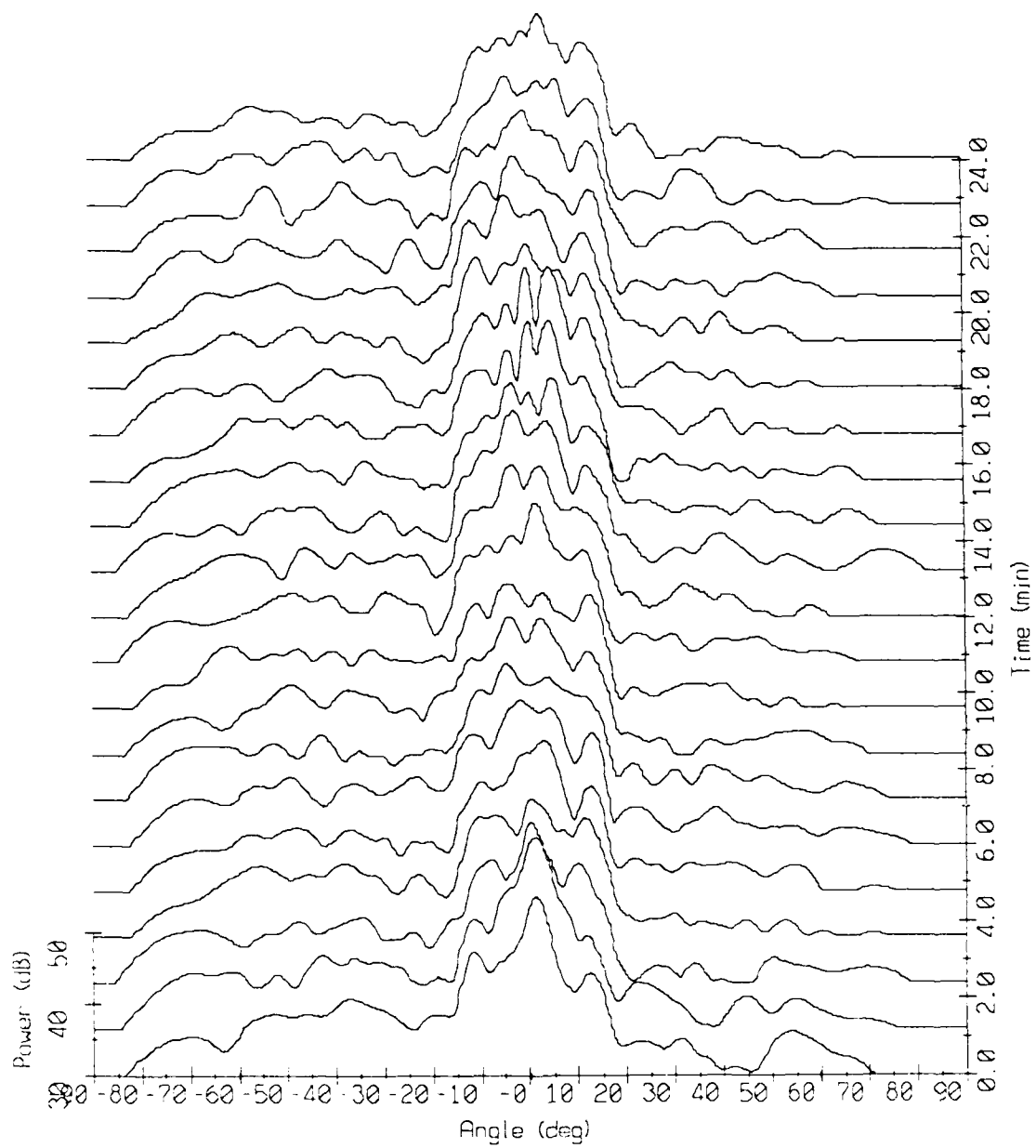
Array Response - 85010 Bin #6354  
 $f = 252 \text{ Hz}$ , KB window ( $\alpha = 1.5$ )



Array Response - 85010 Bin #6579  
 $f = 275 \text{ Hz}$ , KB window ( $\alpha = 1.5$ )

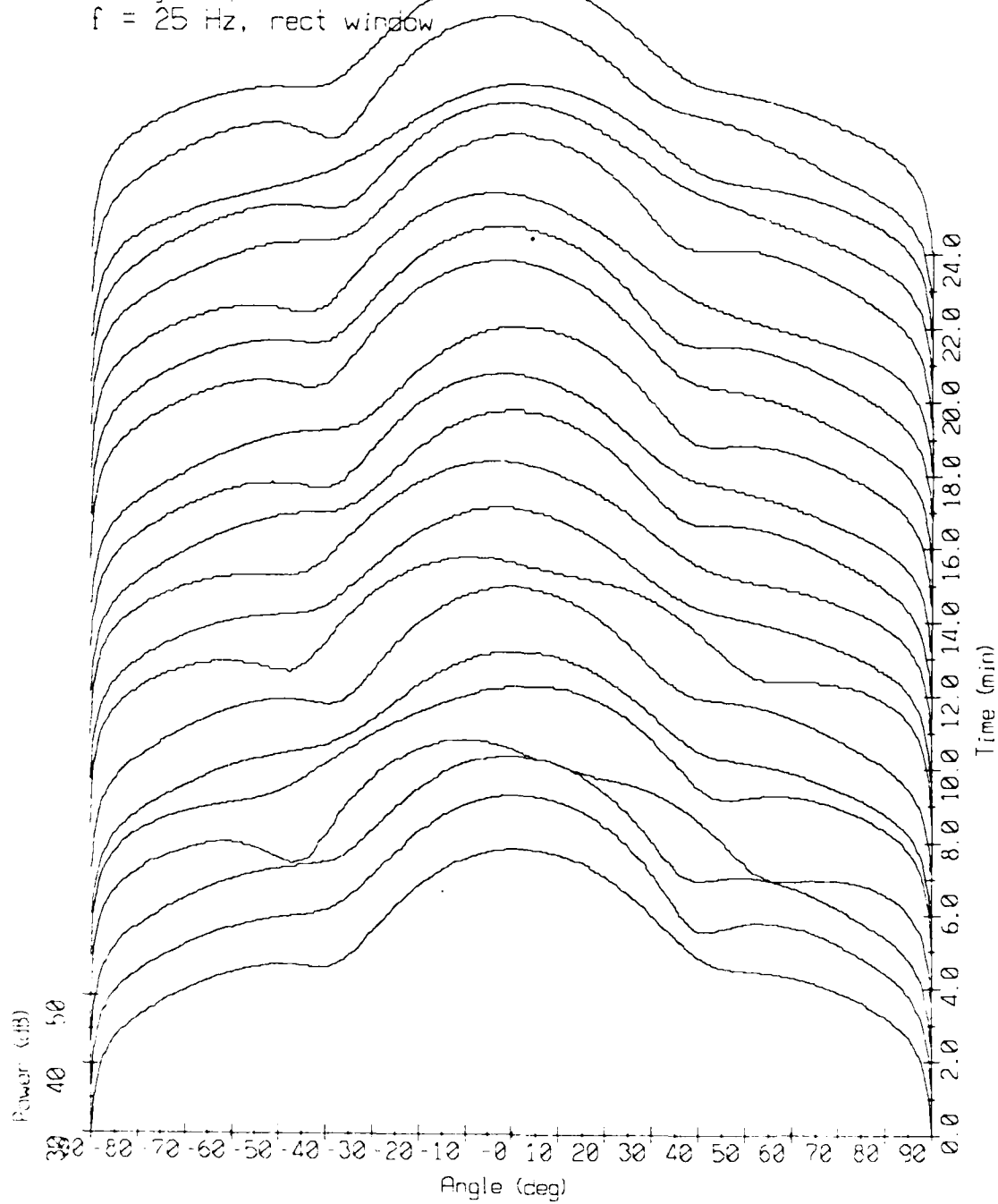


Array Response - 85010 3in #6804  
 $f = 300$  Hz, KB window ( $\alpha = 1.5$ )

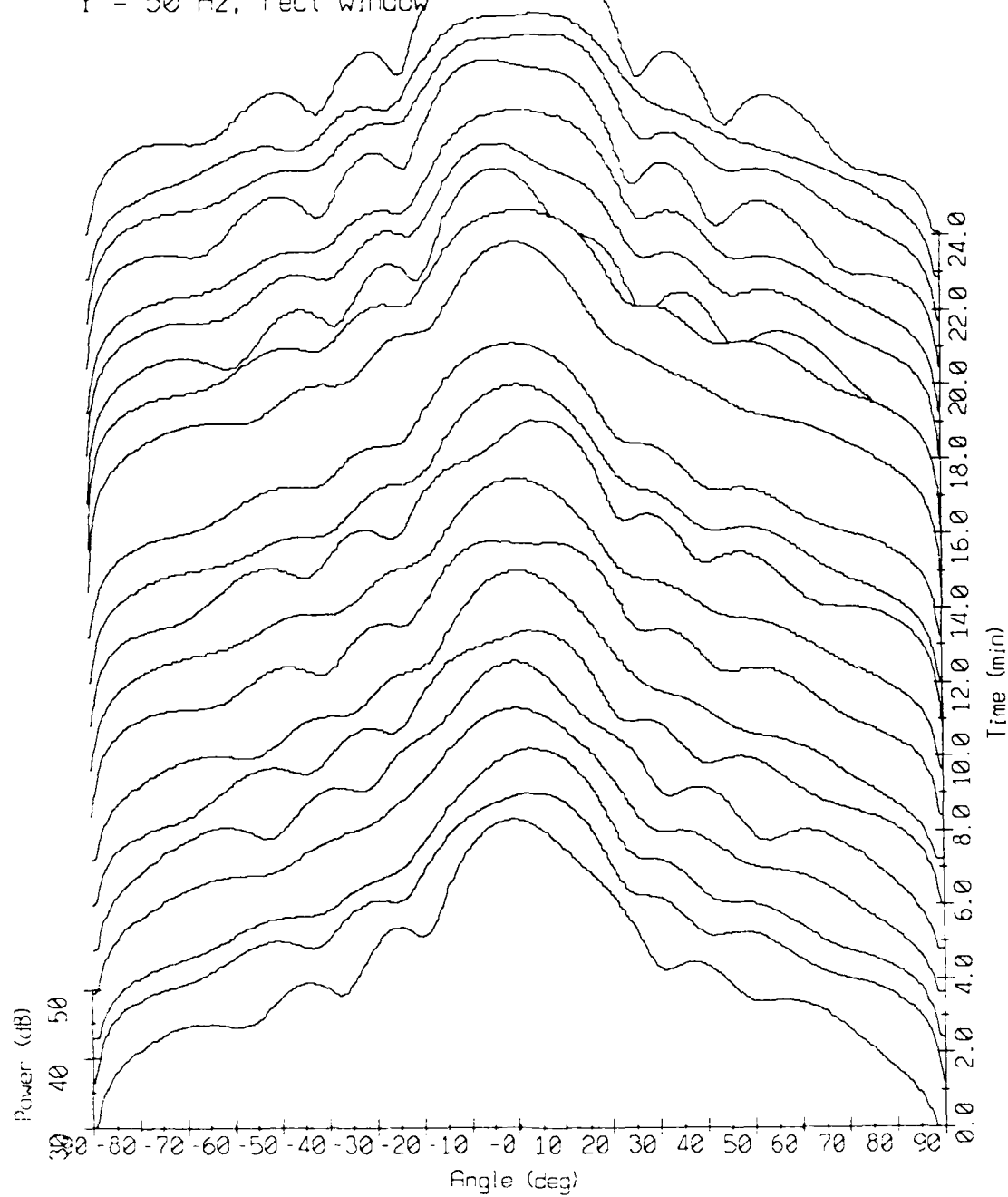


V. Array Response: Waterfall, Rect Window.

Array Response - 85010 Bin #4323  
f = 25 Hz, rect window

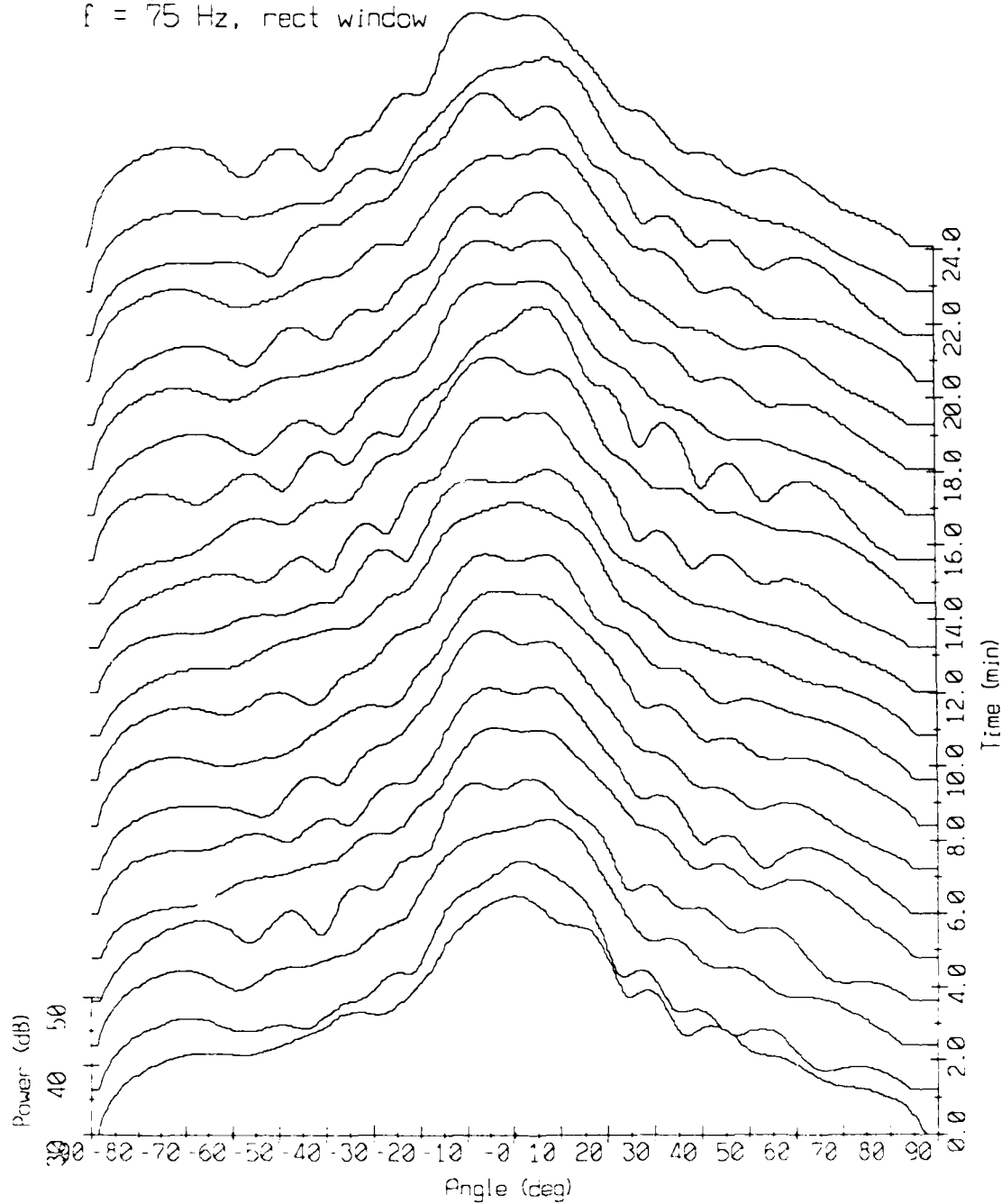


Array Response - 85010 Bin #4548  
f = 50 Hz, rect window

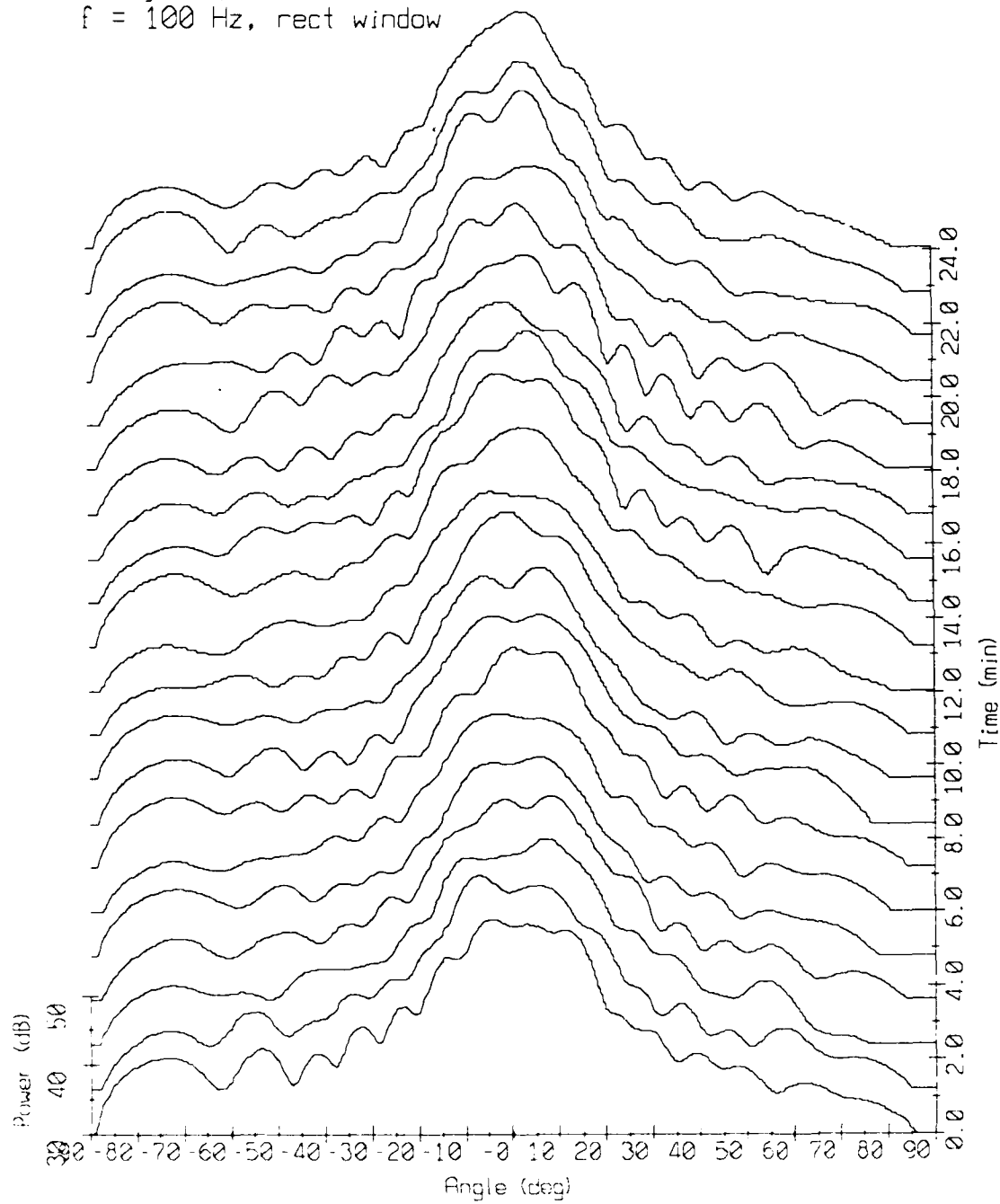




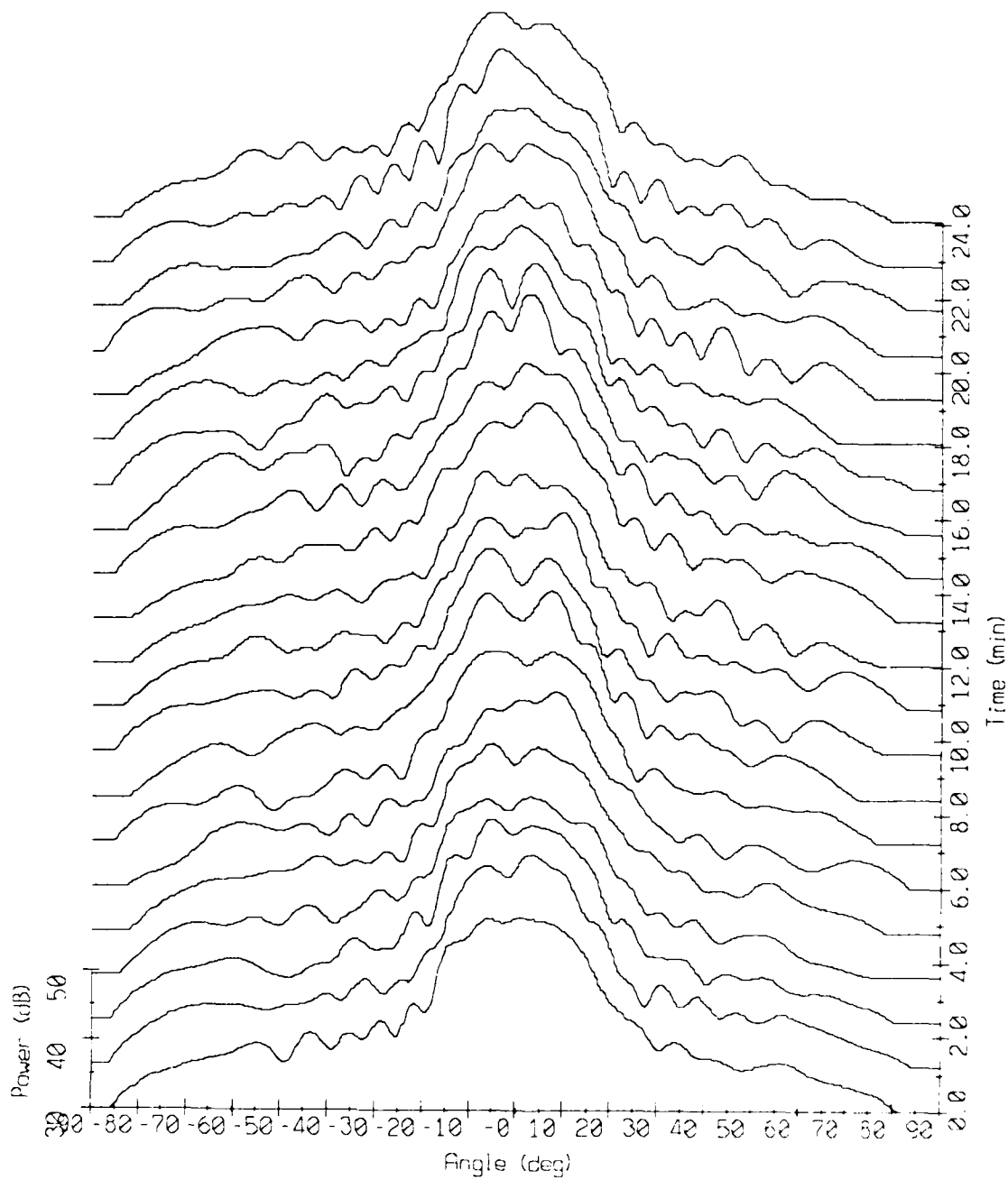
Array Response - 85010 Bin #4774  
 $f = 75$  Hz, rect window



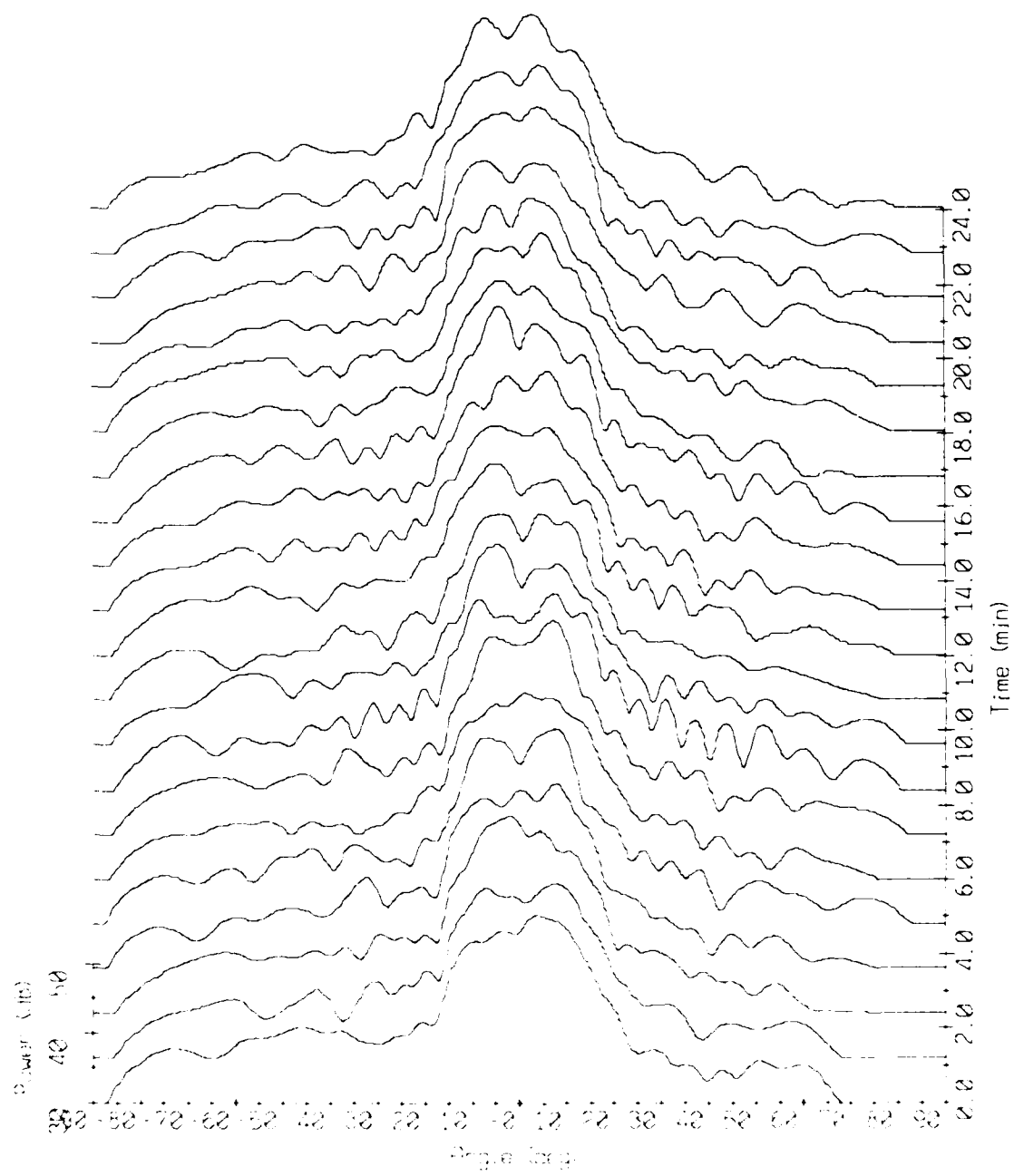
Array Response - 85010 Bin #4999  
f = 100 Hz, rect window



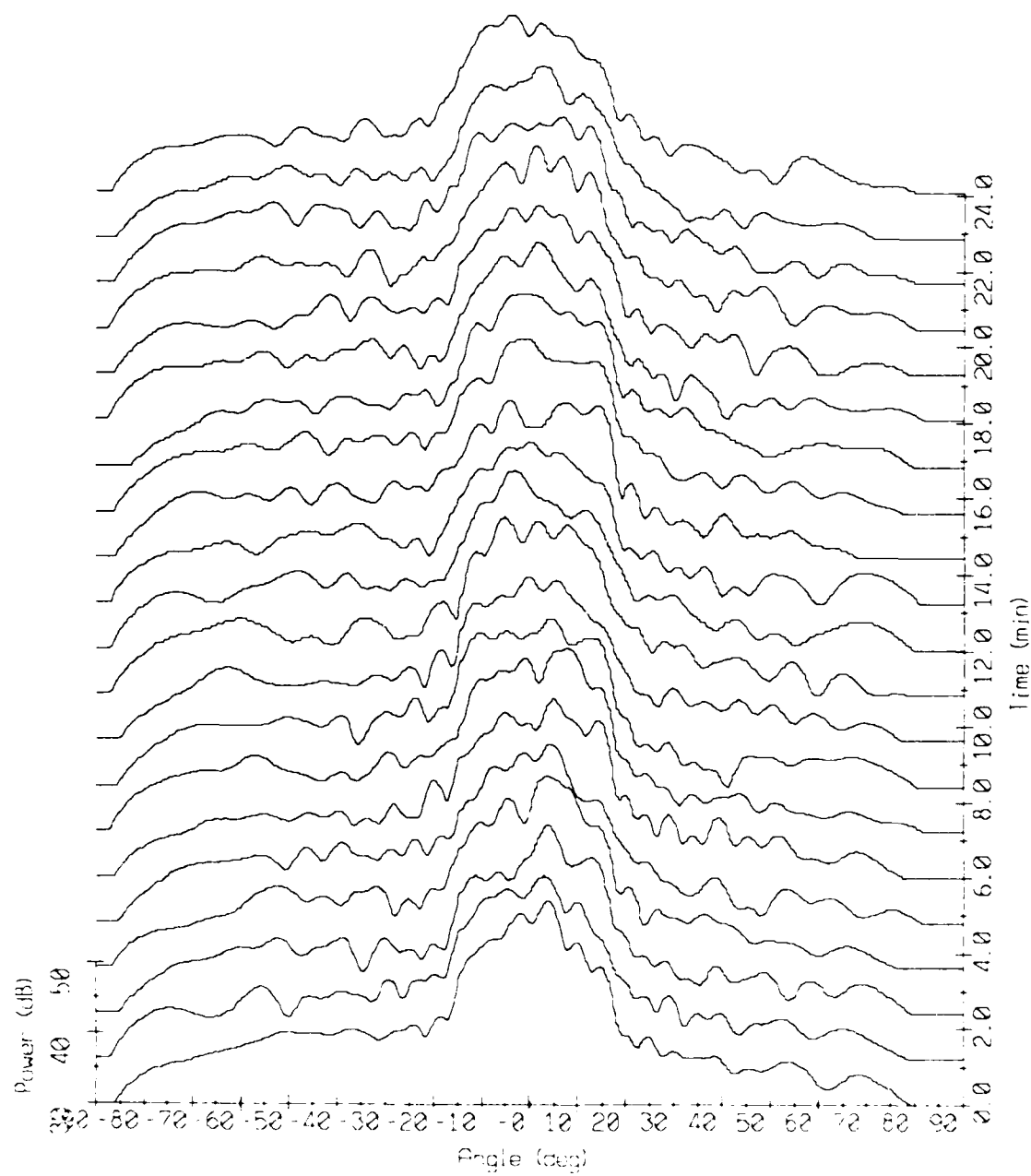
Array Response - 85010 Bin #5225  
f = 125 Hz, rect window



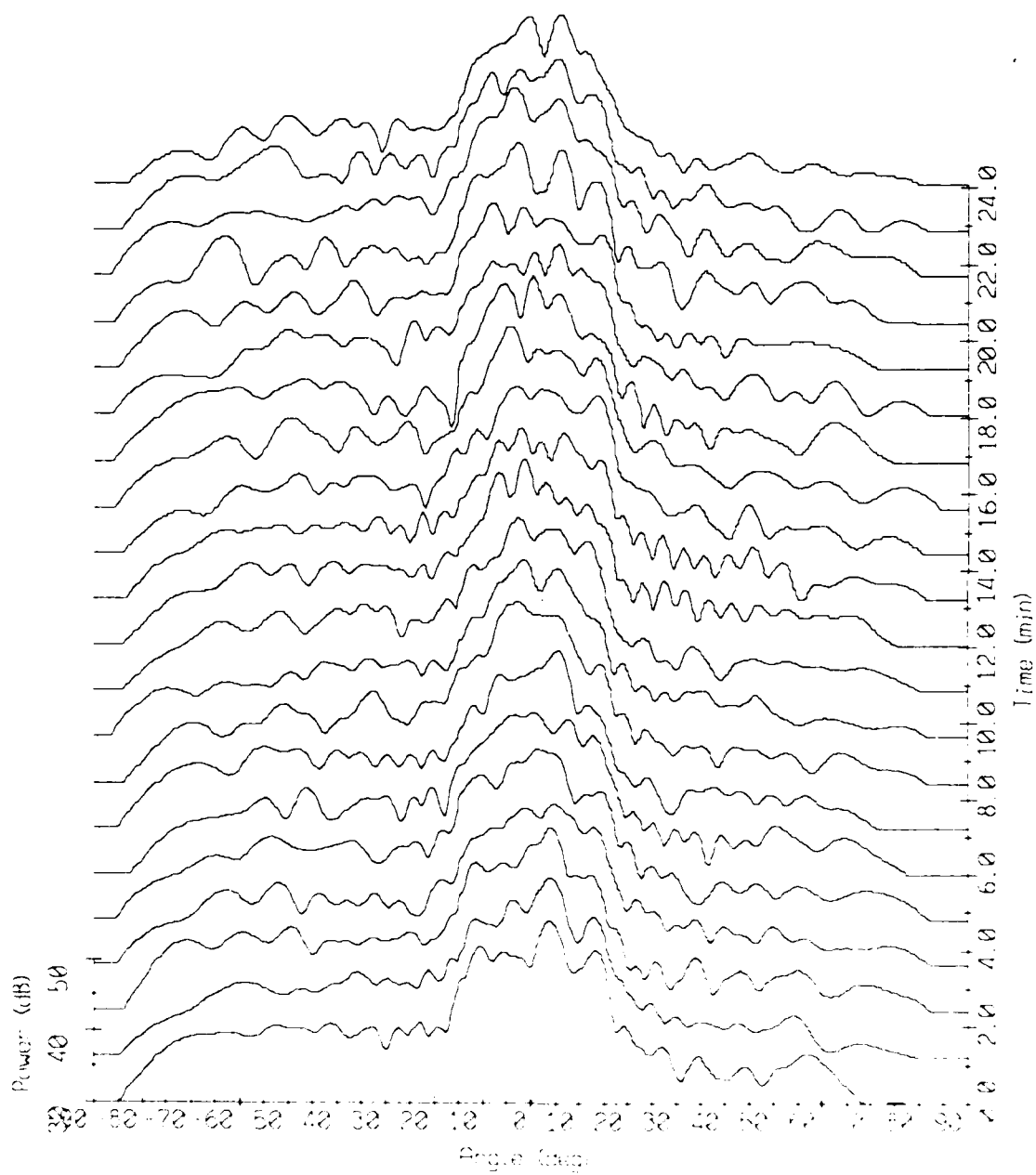
Array Response - 85010 Bin #5451  
 $f = 150$  Hz, rect window



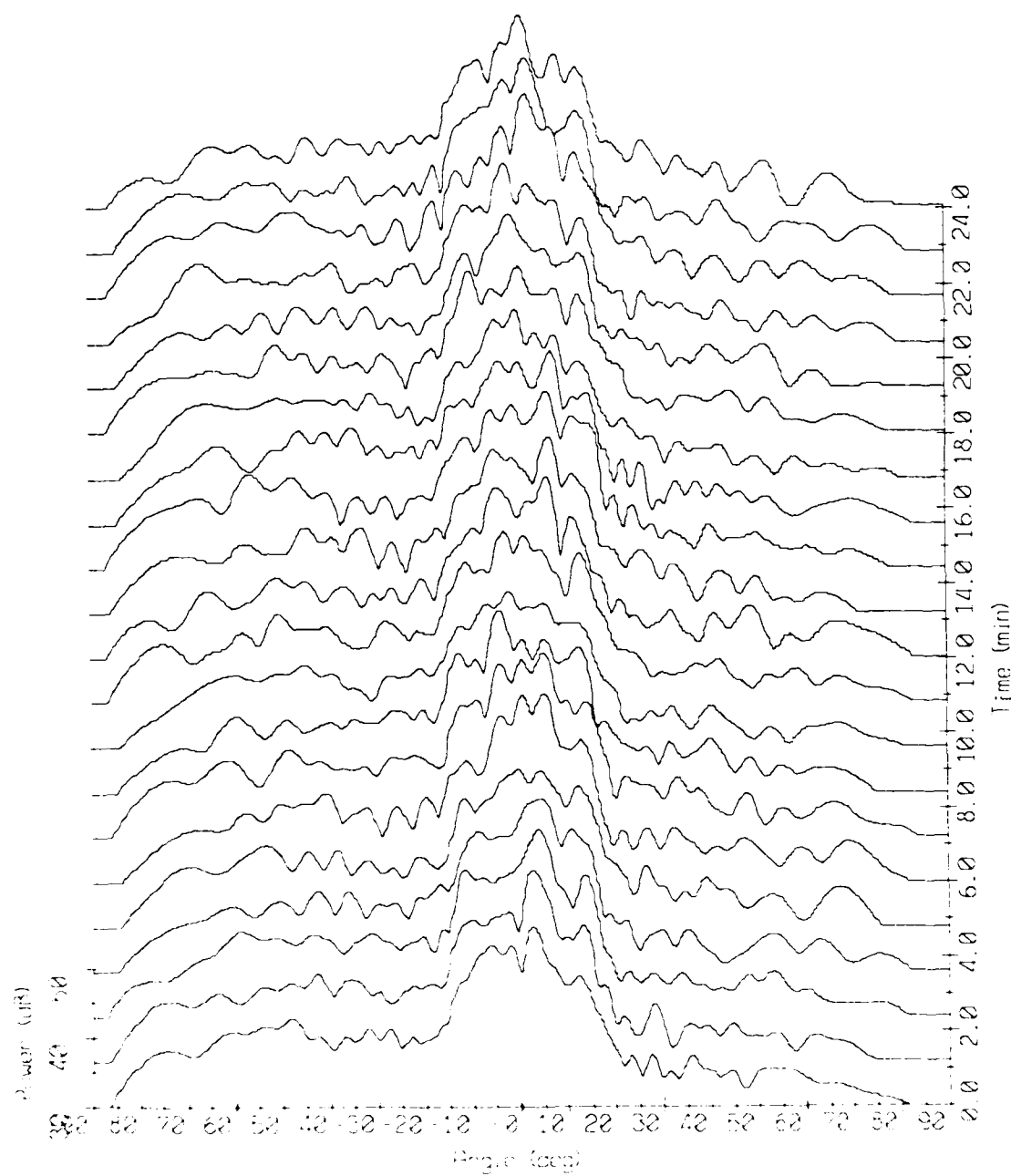
Array Response - 85010 Bin #5676  
 $f = 175$  Hz, rect window



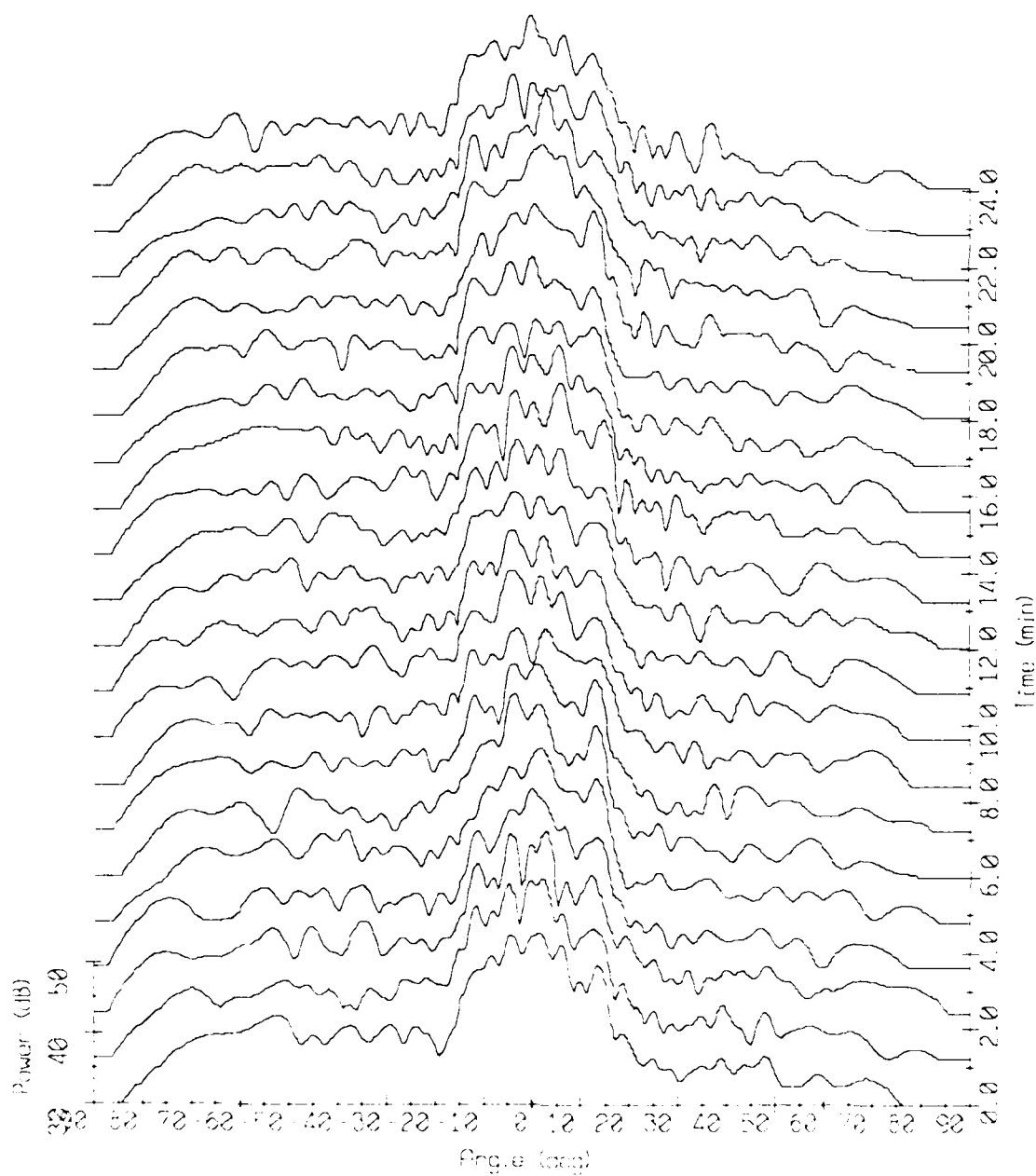
Array Response - 85010 Bin #5902  
f = 200 Hz, rect window



Array Response - 85010 Bin #6127  
 $f = 225$  Hz, rect window

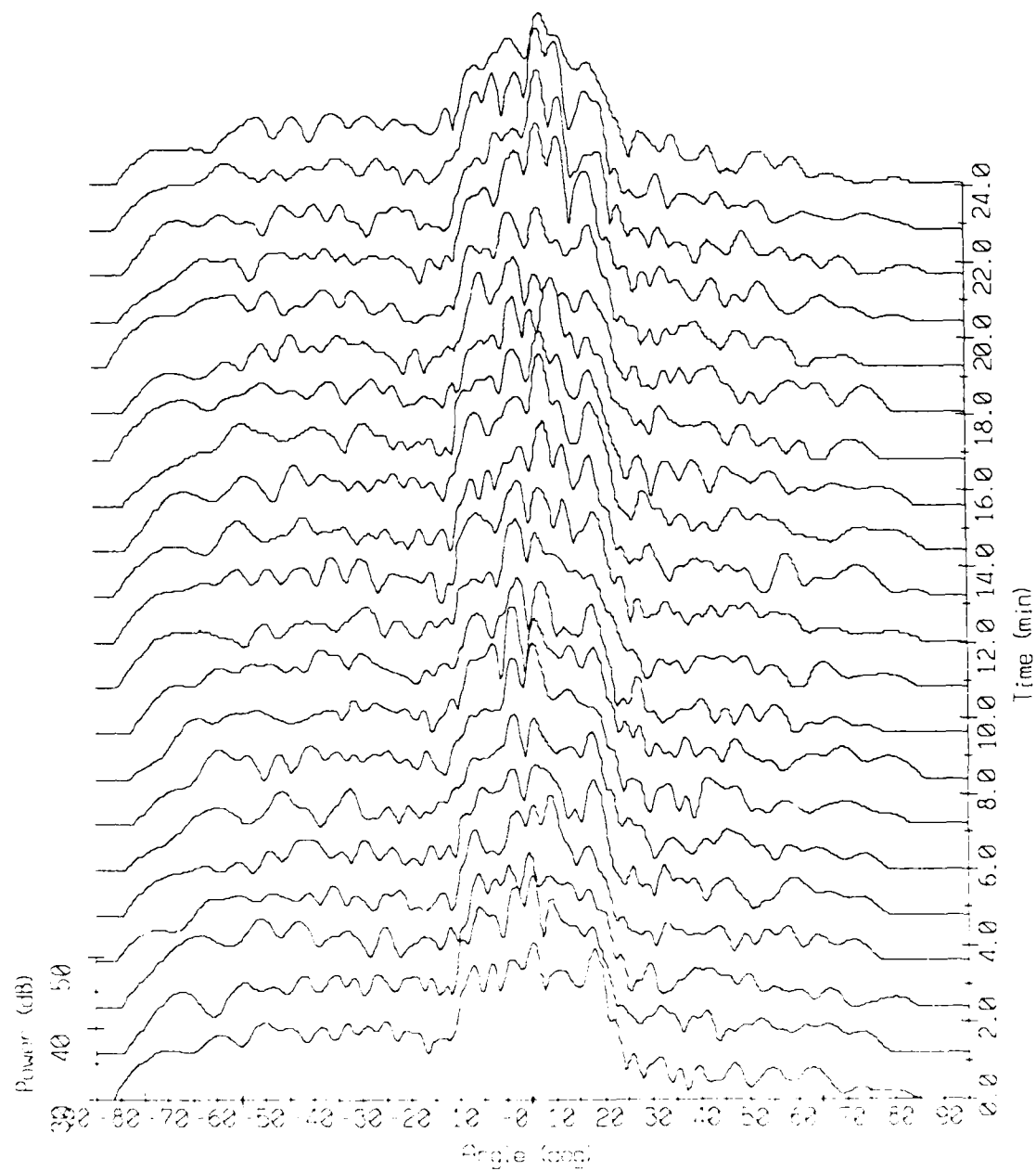


Array Response - 85010 Bin #6354  
 $f = 252$  Hz, rect window



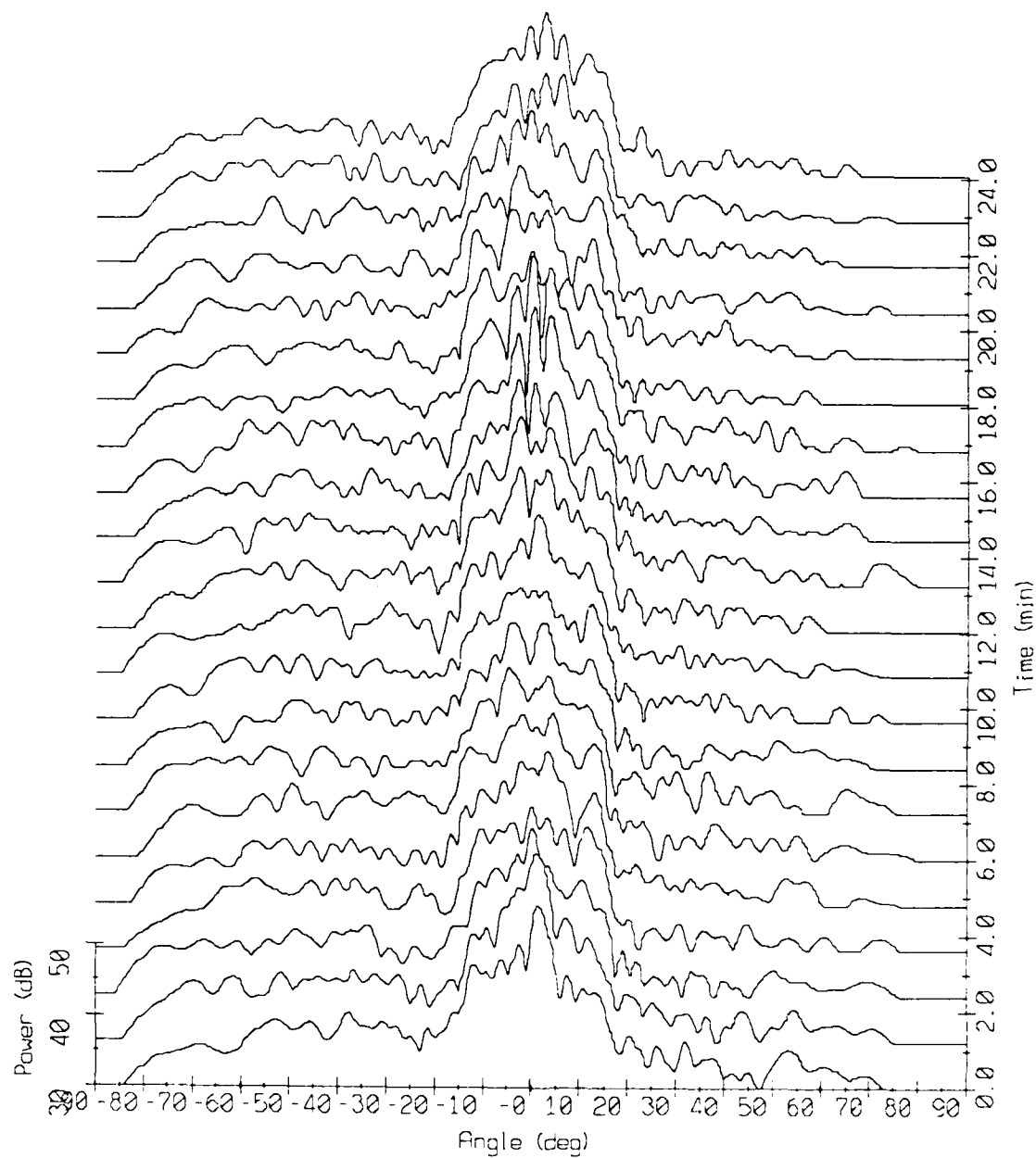


Array Response - 85010 Bin #6579  
 $f = 275$  Hz, rect window



Array Response - 85010 Bin #6804

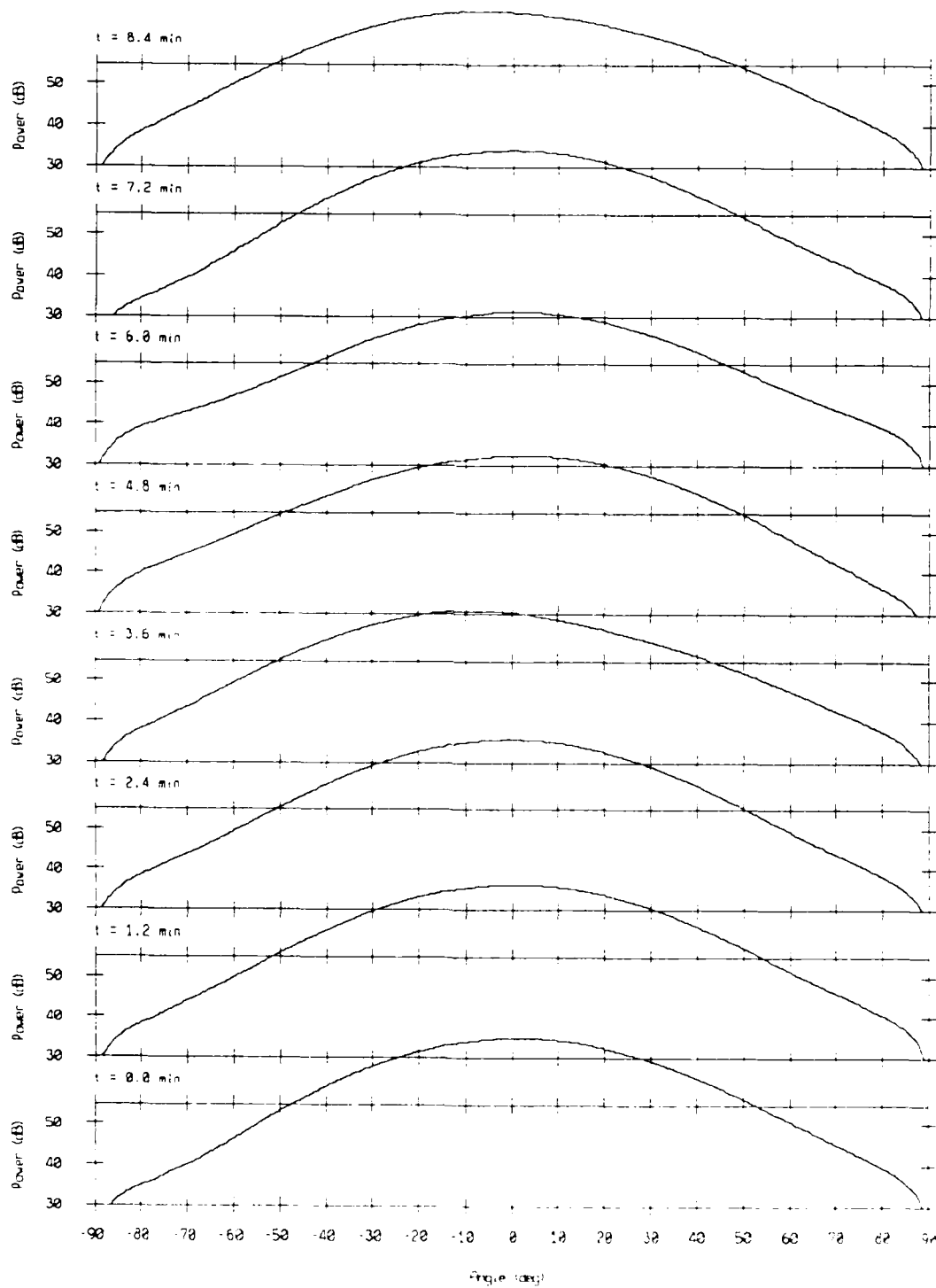
f = 300 Hz, rect window



## VI. Array Response: Panels, KB Window.

Array Response - 85010 Bin #4323

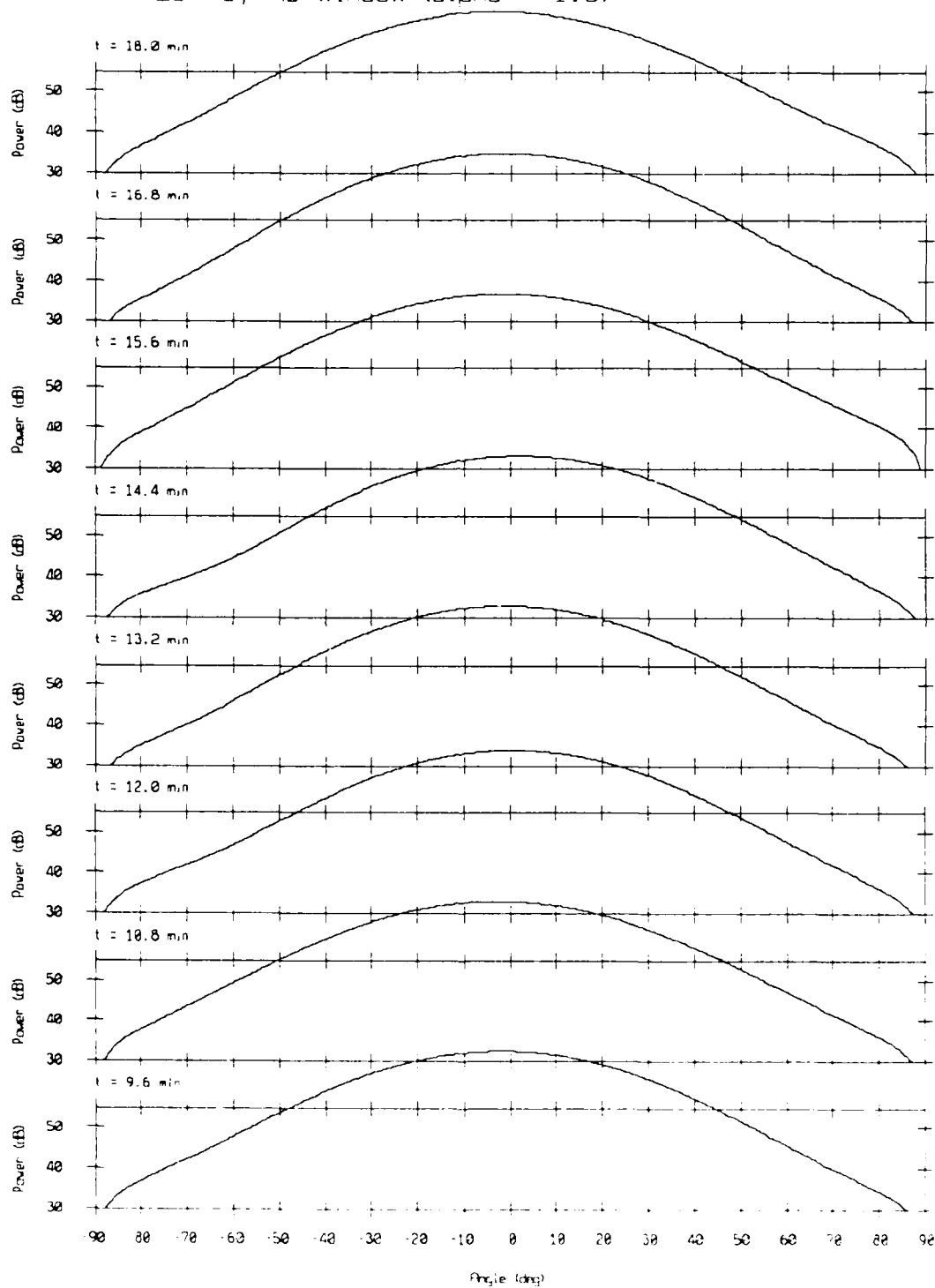
$f = 25$  Hz, KB window ( $\alpha_{\text{pnc}} = 1.5$ )



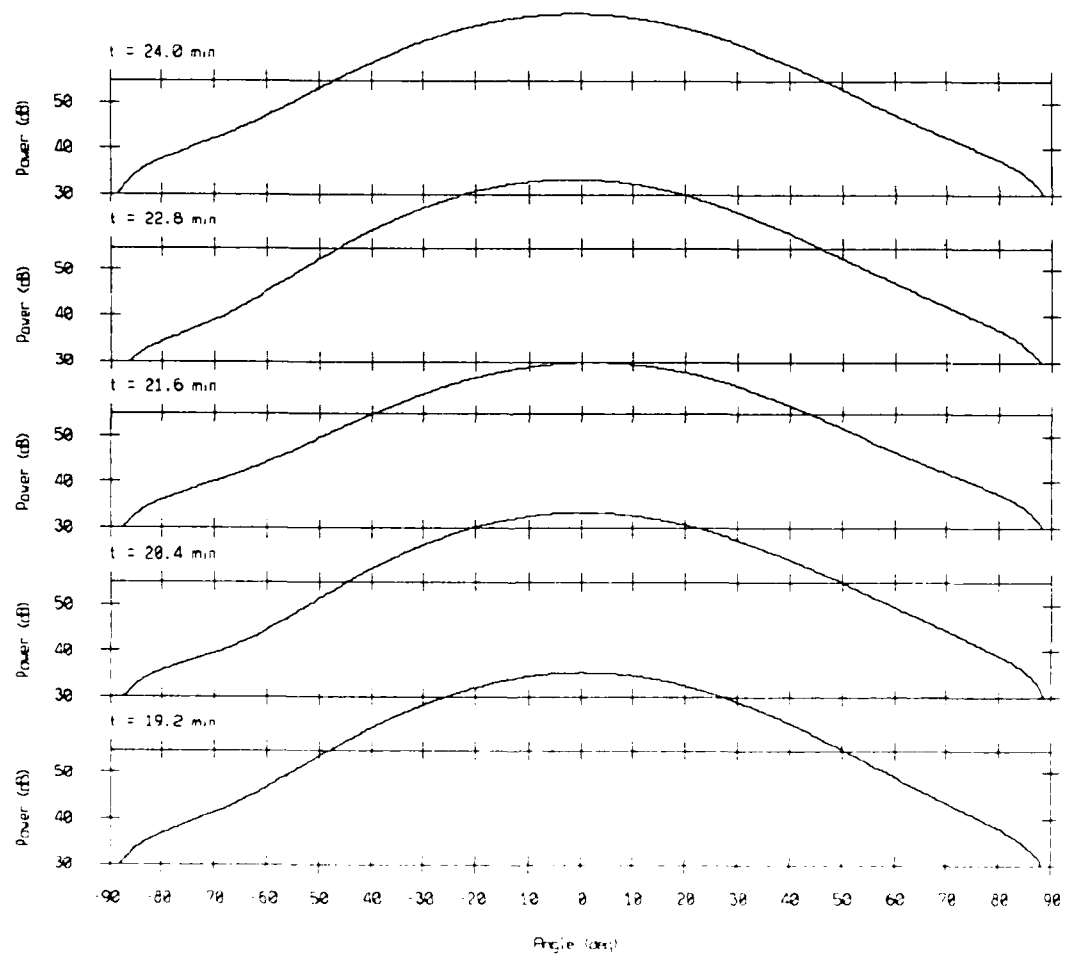
Angle (deg)

Array Response - 85010 Bin #4323

$f = 25$  Hz, KB window ( $\alpha = 1.5$ )

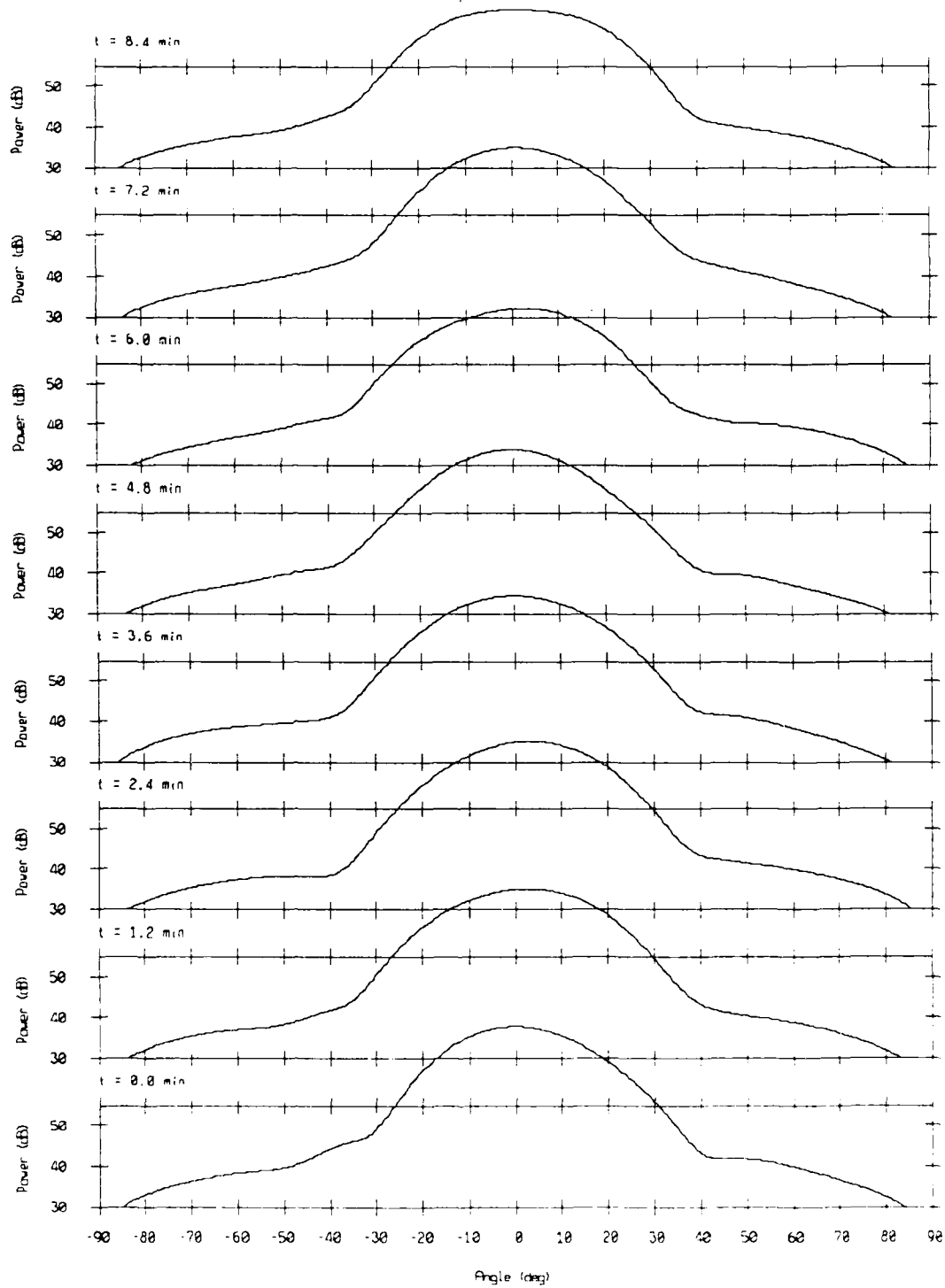


Array Response - 85010 Bin #4323  
 $f = 25$  Hz, KB window ( $\alpha = 1.5$ )



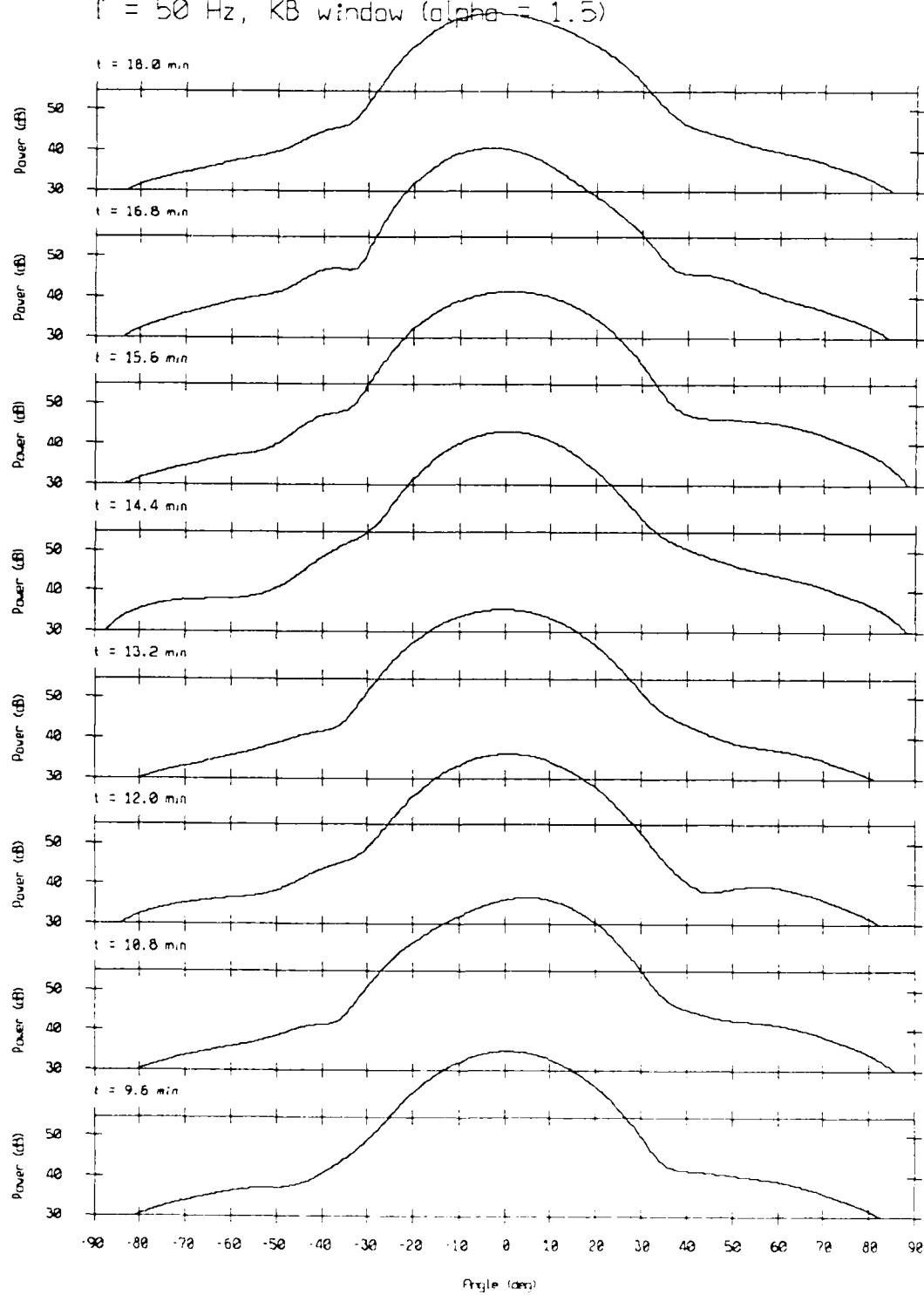
Array Response - 85010 Bin #4548

$f = 50$  Hz, KB window ( $\alpha = 1.5$ )



Array Response - 85010 Bin #4548

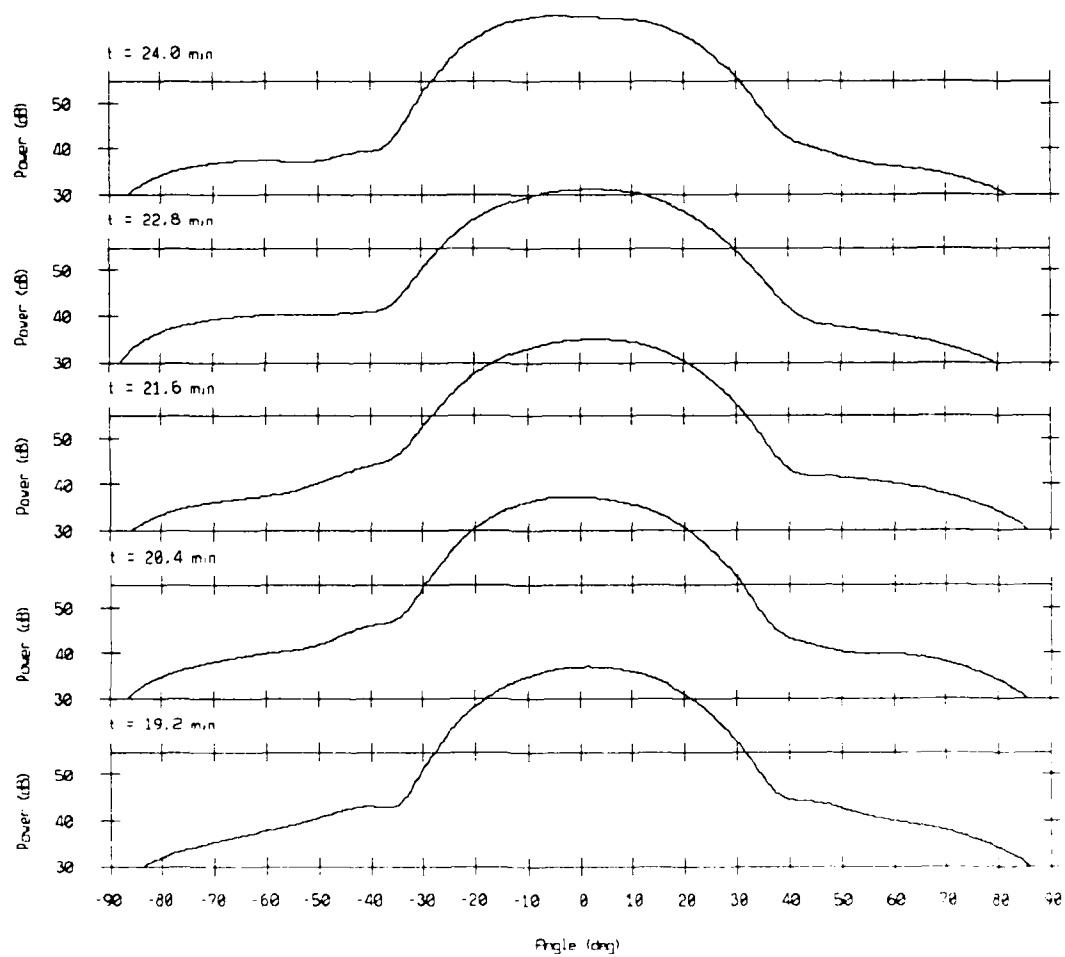
$f = 50$  Hz, KB window ( $\alpha = 1.5$ )





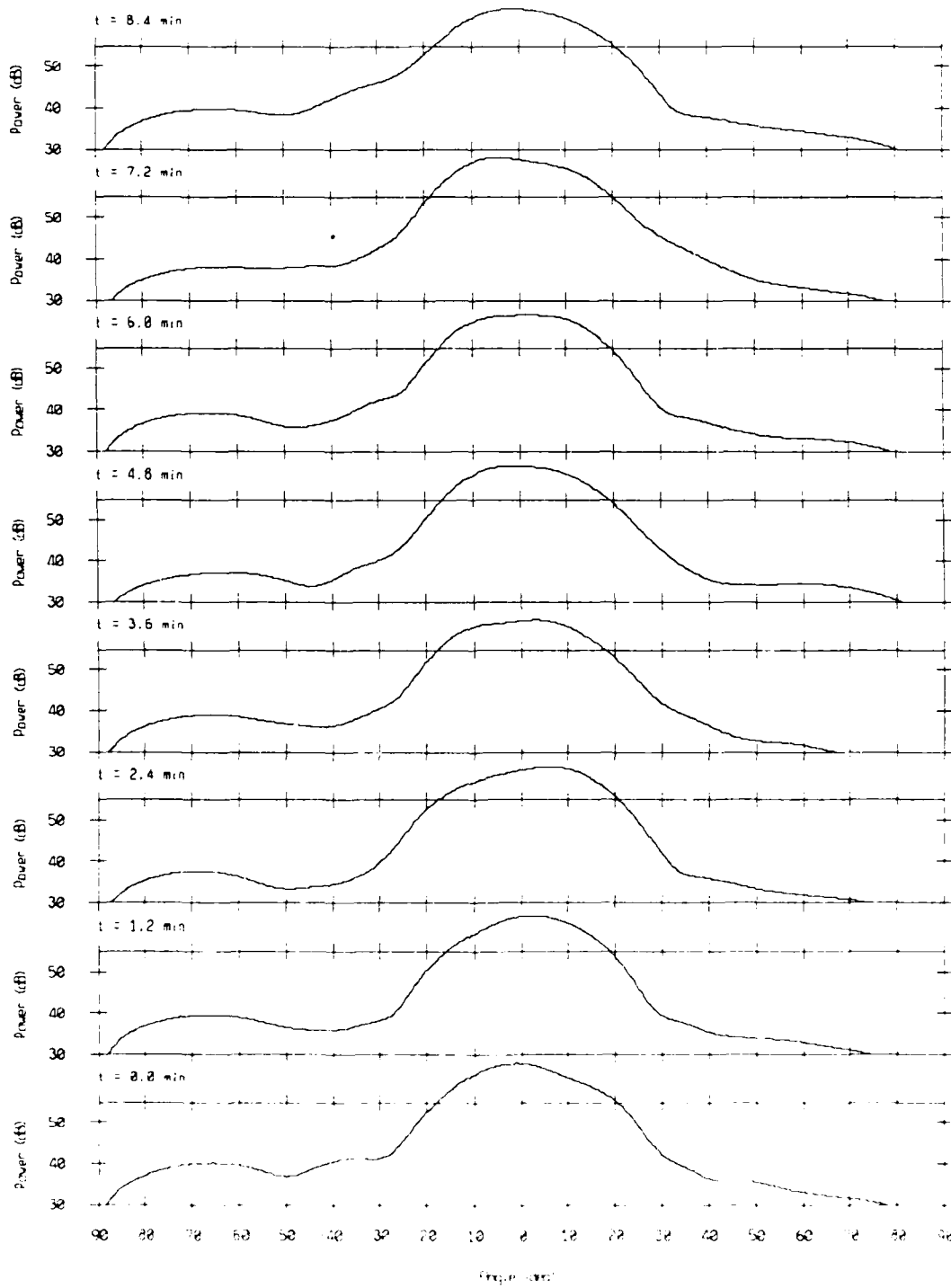
Array Response - 85010 Bin #4548

$f = 50$  Hz, KB window ( $\alpha = 1.5$ )



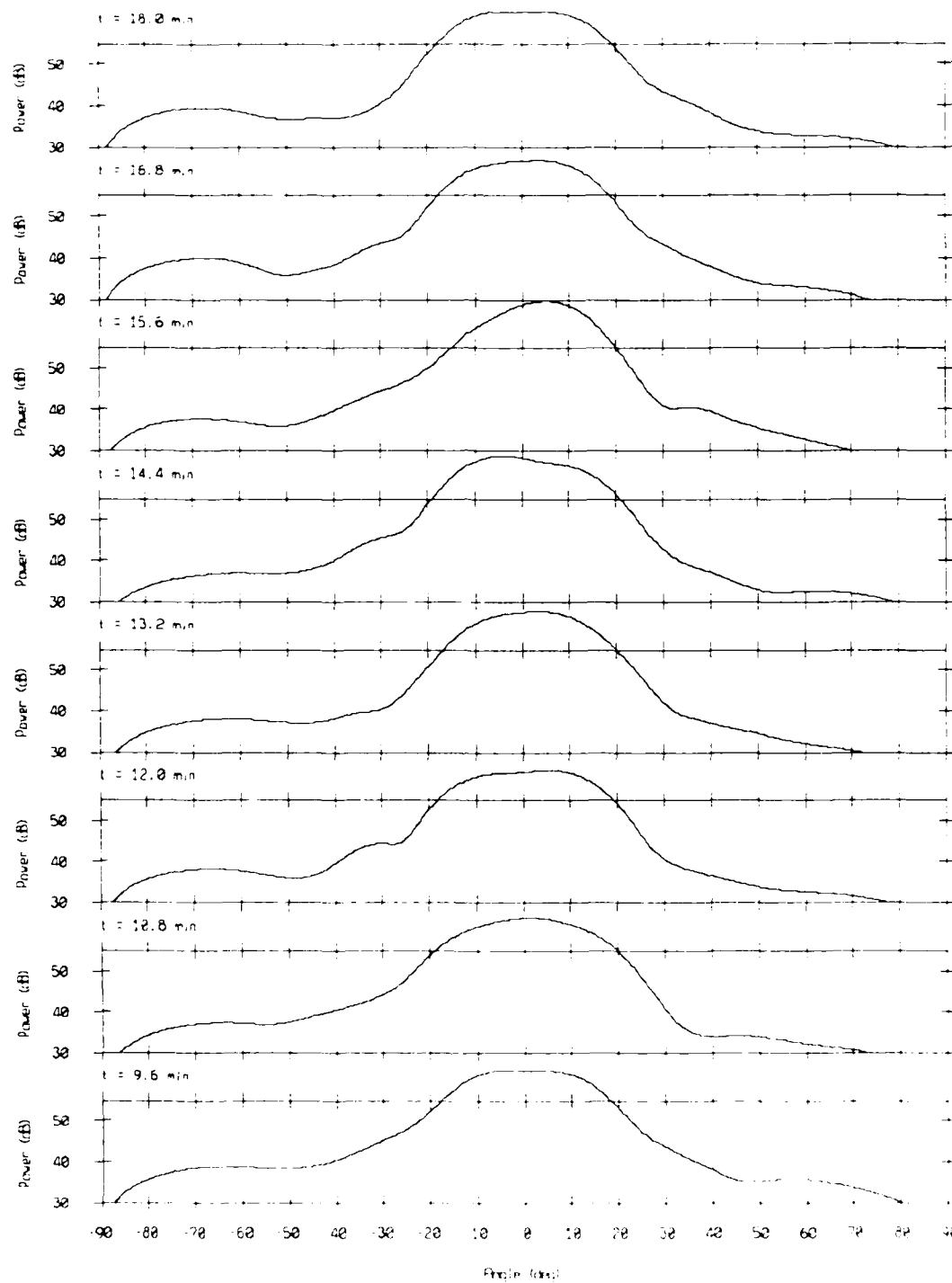
Array Response - 85010 Bin #4774

$f = 75$  Hz, KB window (alpha = 1.5)



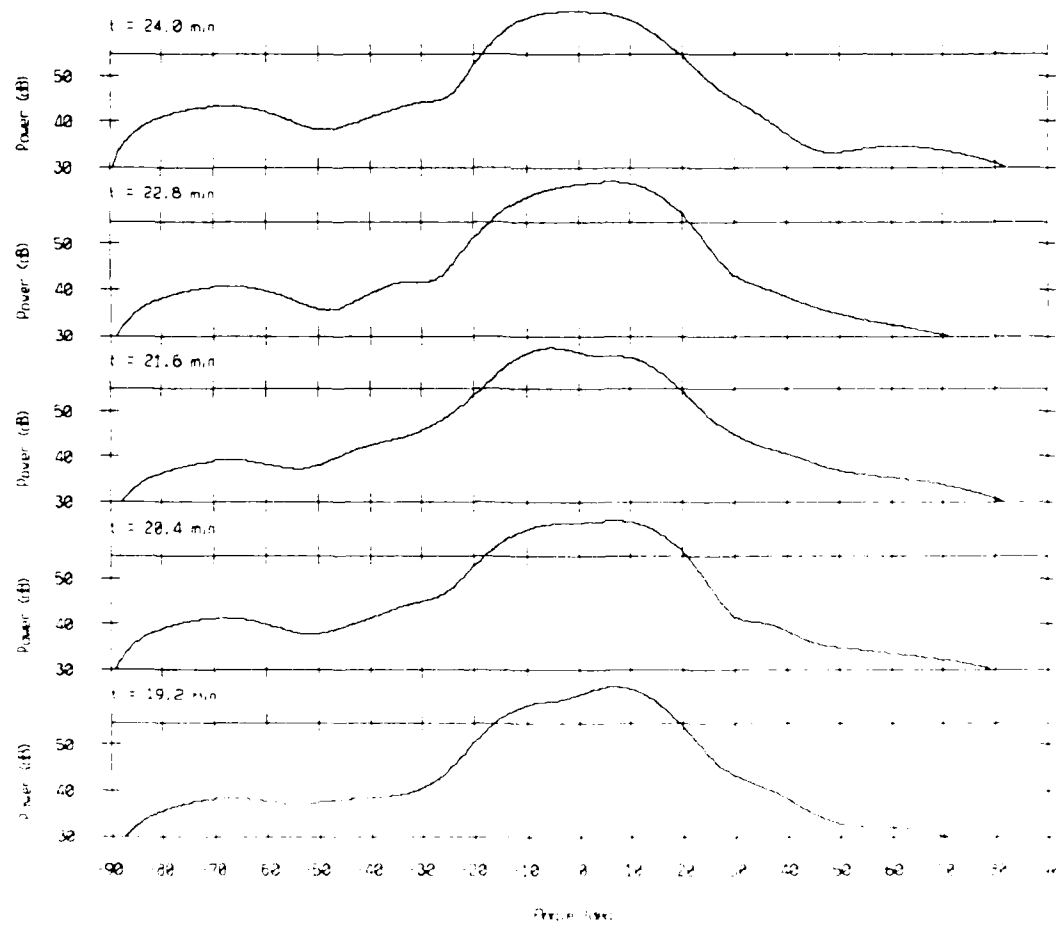
Acq. Response - 85010 Bin #4774

$f = 75$  Hz,  $\Delta B$  window (band = 1.5)



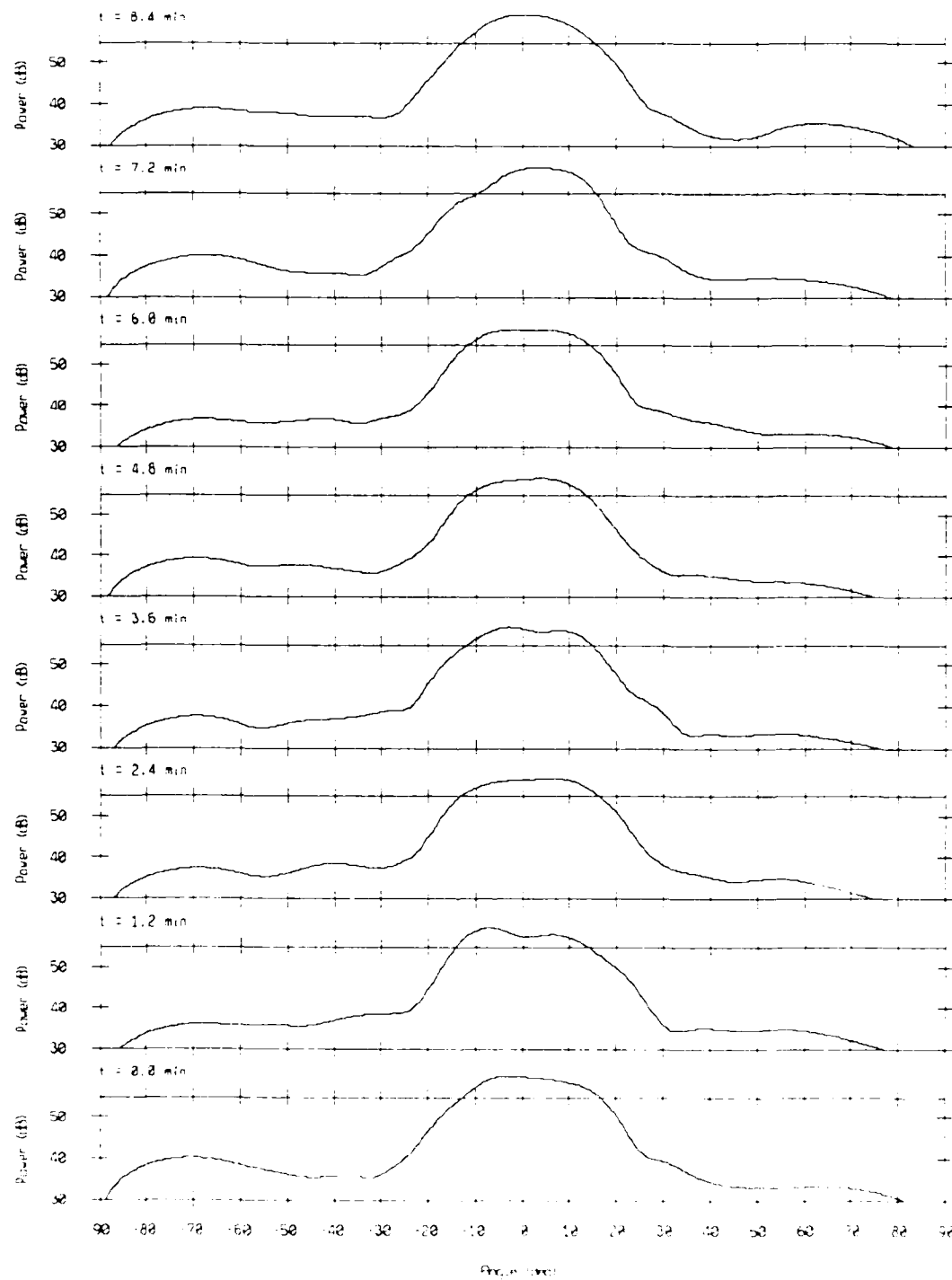
Ampl. Response - 85012 3in #4774

$f = 75$  Hz,  $\Delta f$  window (octave) = 1.5



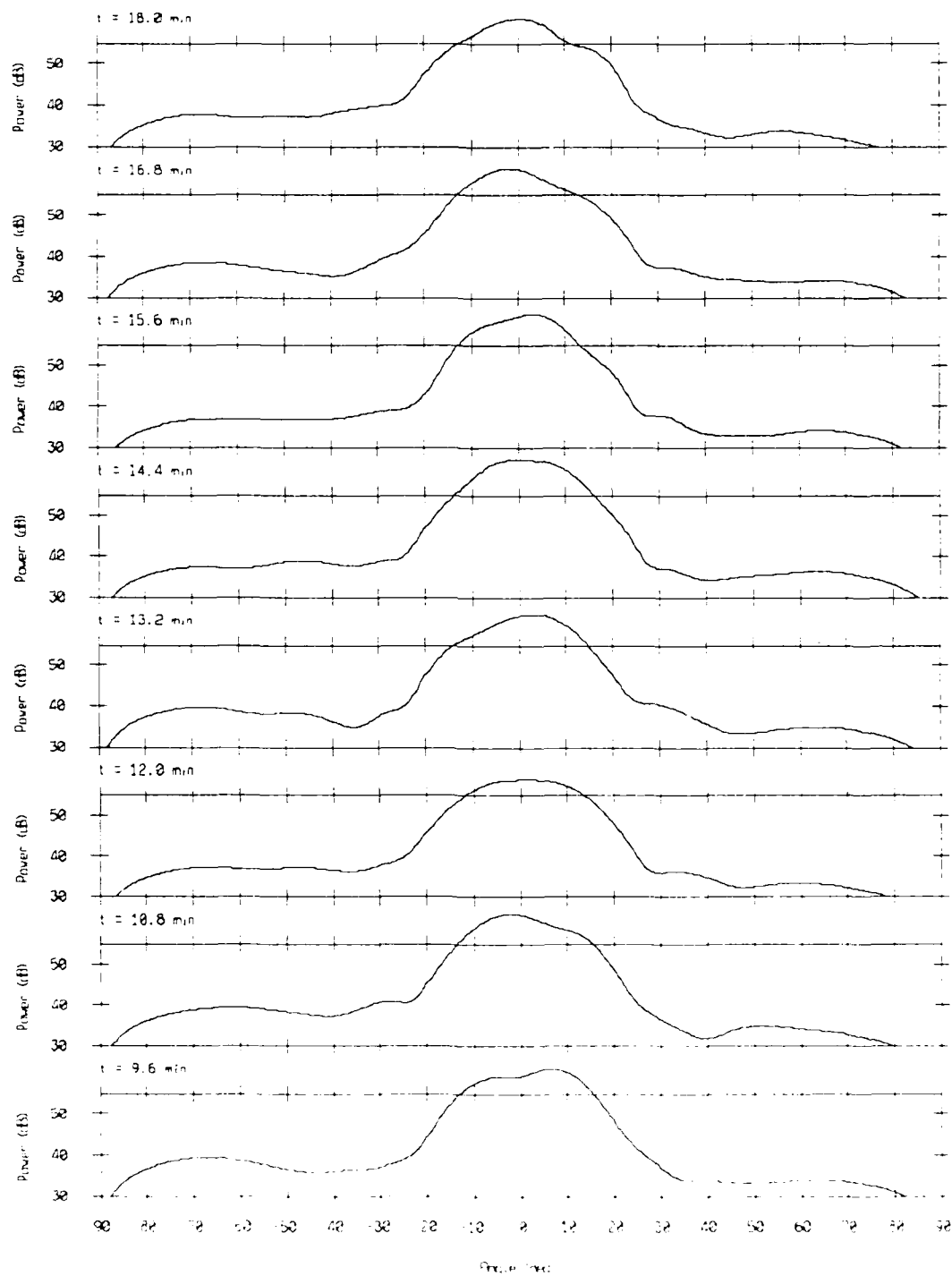
Array Response - 85010 Bin #4999

$f = 100$  Hz, K5 window (alpha = 1.5)



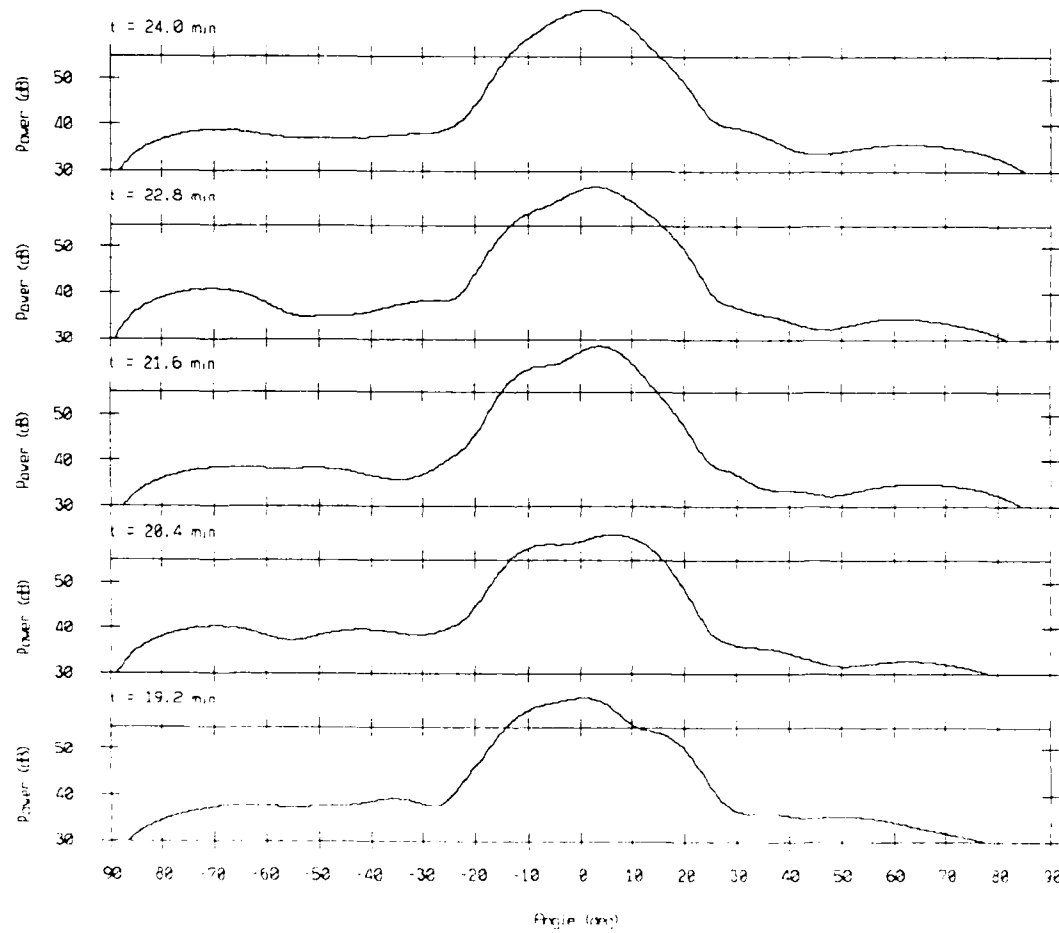
Array Response - 85010 Bin #4999

$f = 100$  Hz, KB window ( $\alpha = 1.5$ )



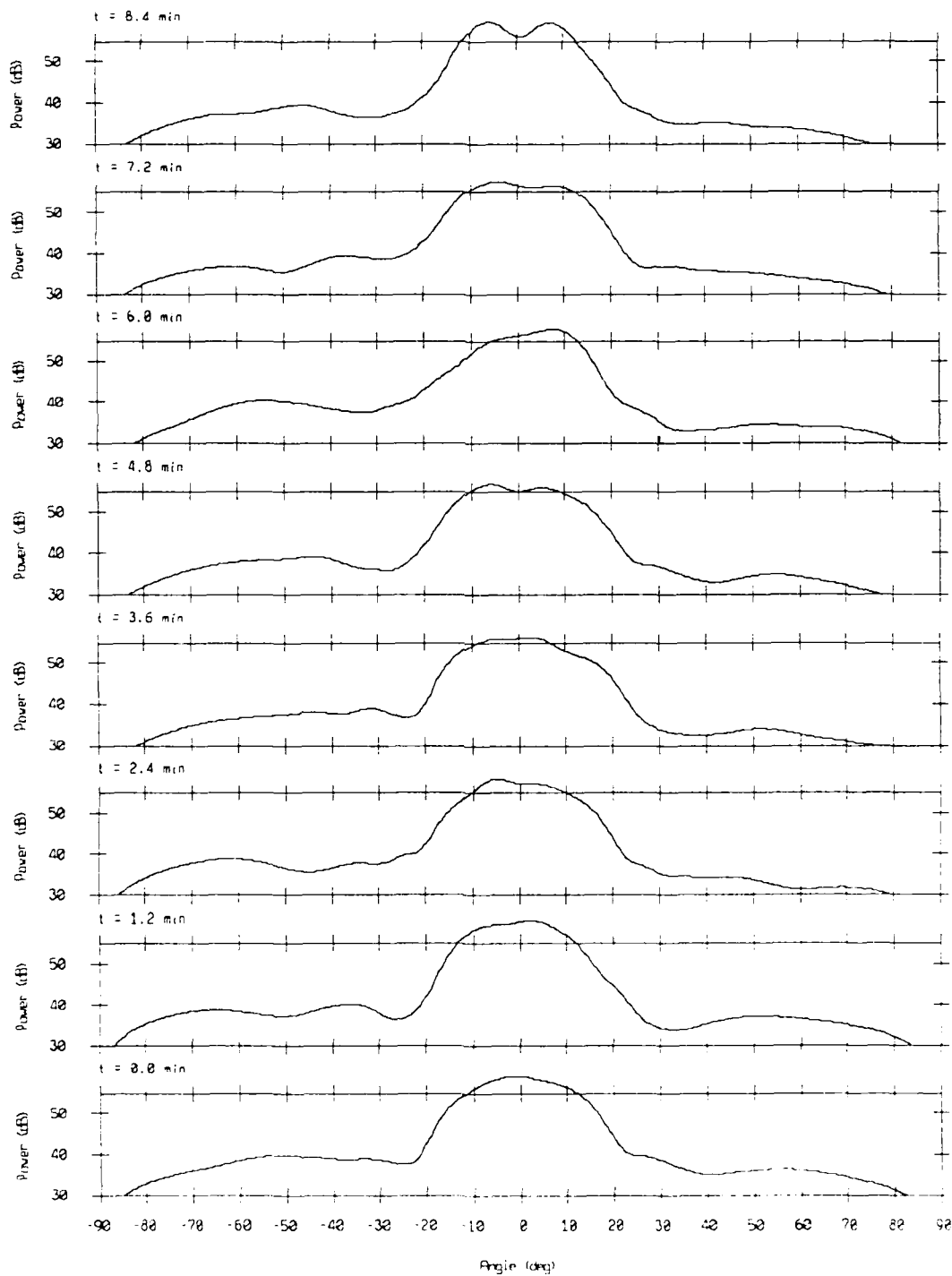
Array Response - 85010 Bin #4999

$f = 120$  Hz, KB window ( $\alpha = 1.5$ )



Array Response - 85010 Bin #5225

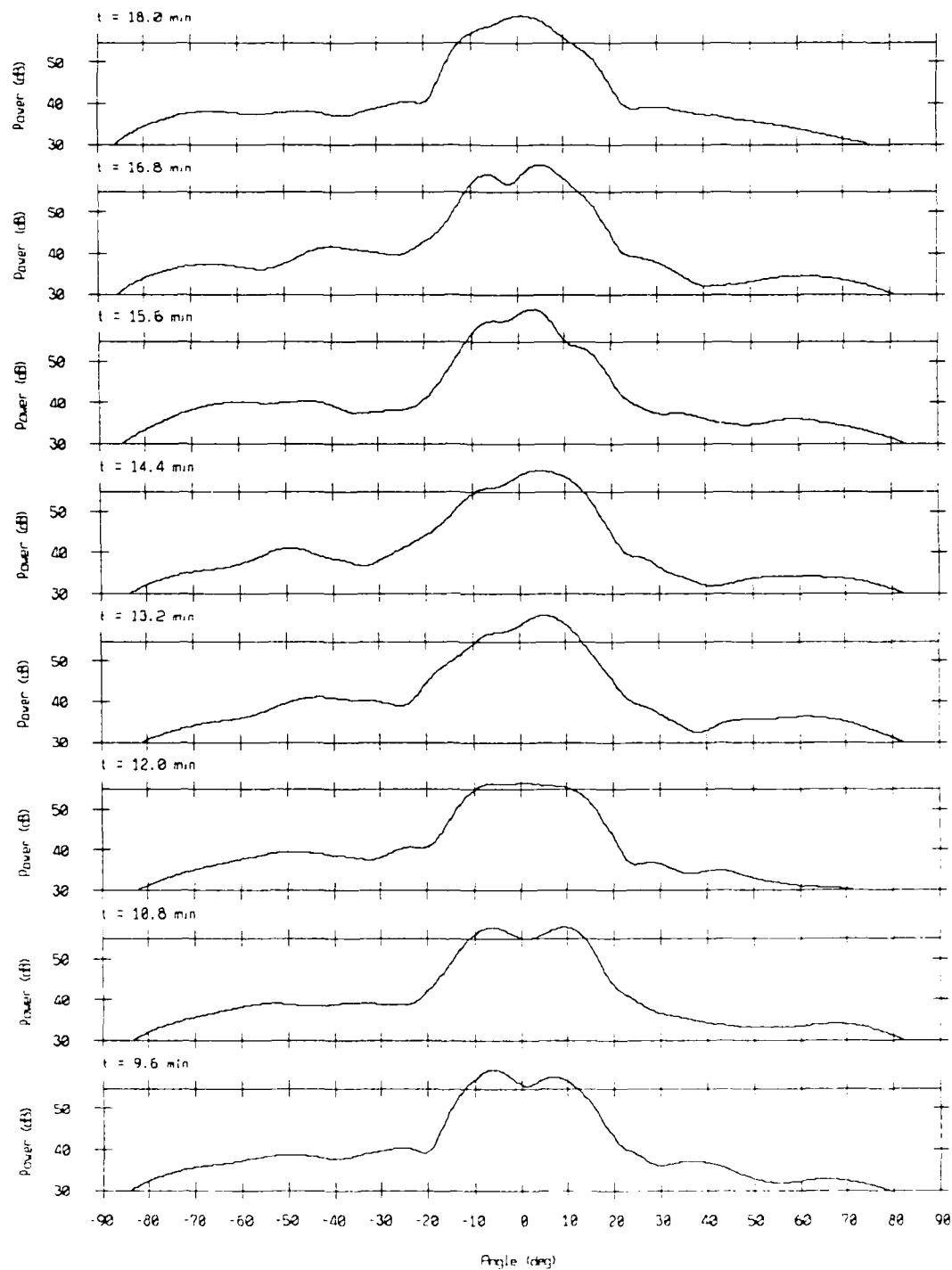
$f = 125$  Hz, KB window ( $\alpha = 1.5$ )





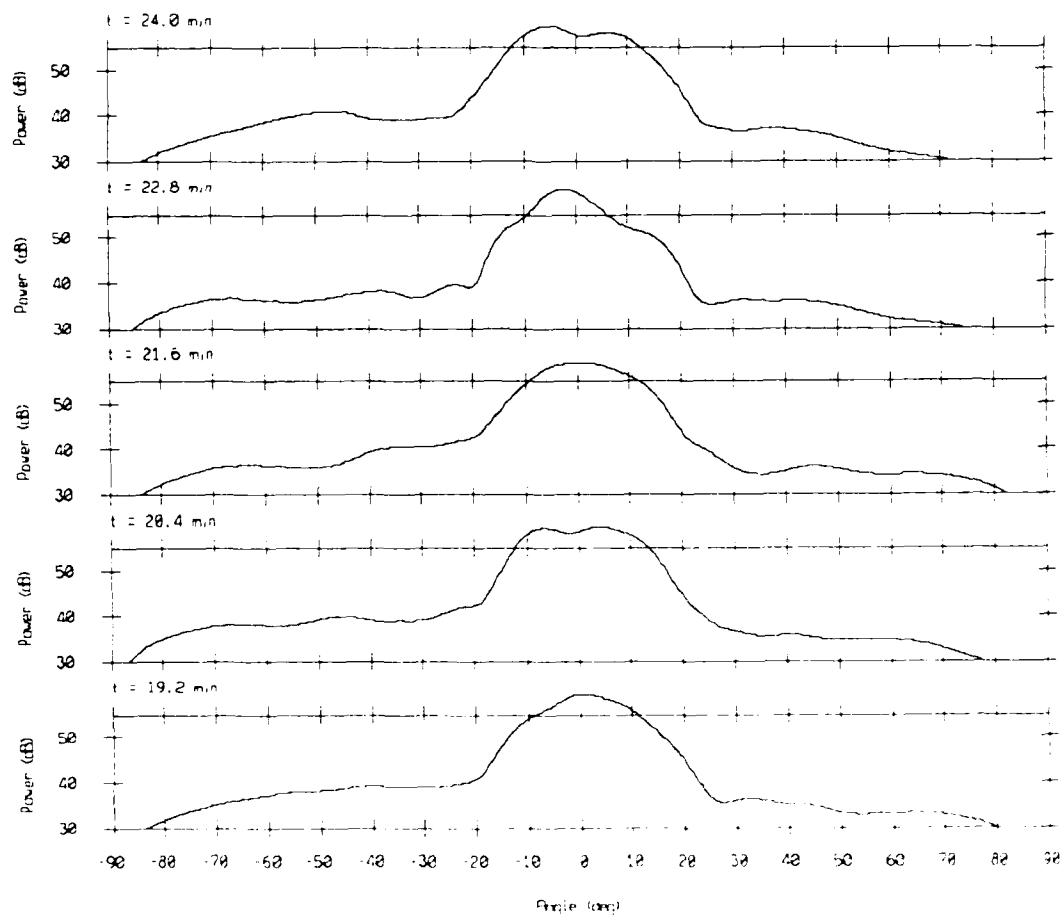
Array Response - 85010 Bin #5225

$f = 125$  Hz, KB window ( $\alpha = 1.5$ )



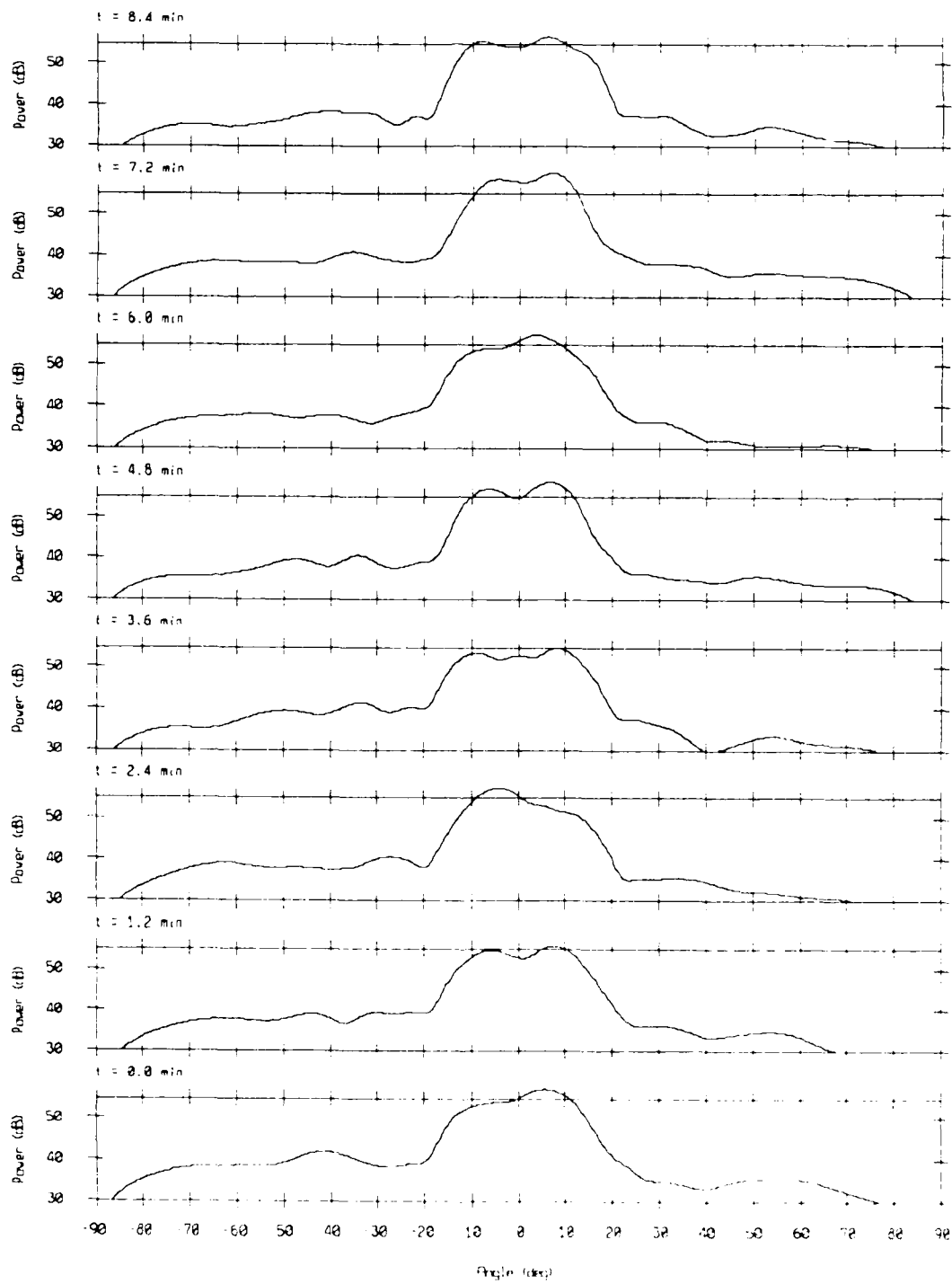
Array Response - 85010 Bin #5225

$f = 125$  Hz, KB window ( $\alpha = 1.5$ )



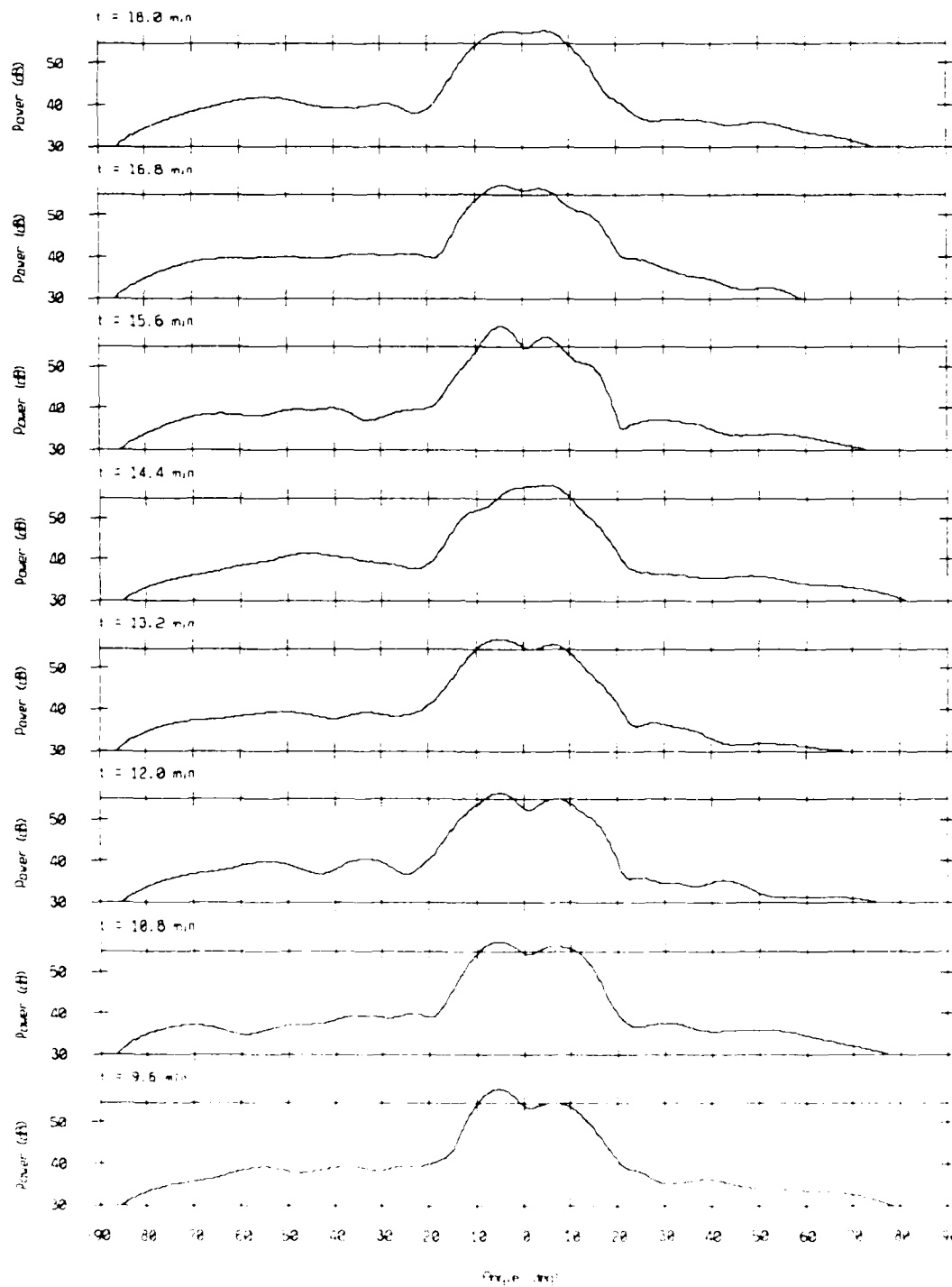
Array Response - 85010 Bin #5451

$f = 150$  Hz, KB window ( $\alpha_{\text{prc}} = 1.5$ )



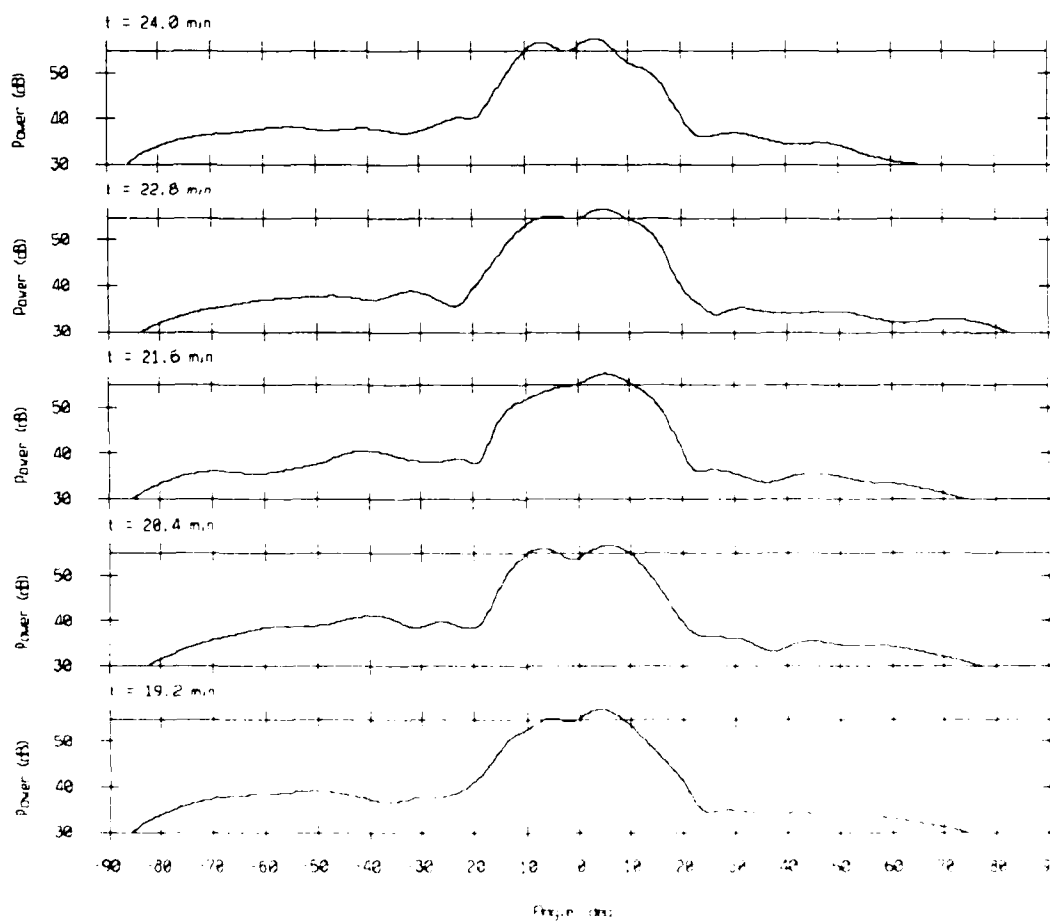
Array Response - 85010 Bin #5451

$f = 150$  Hz, KB window ( $\alpha = 1.5$ )



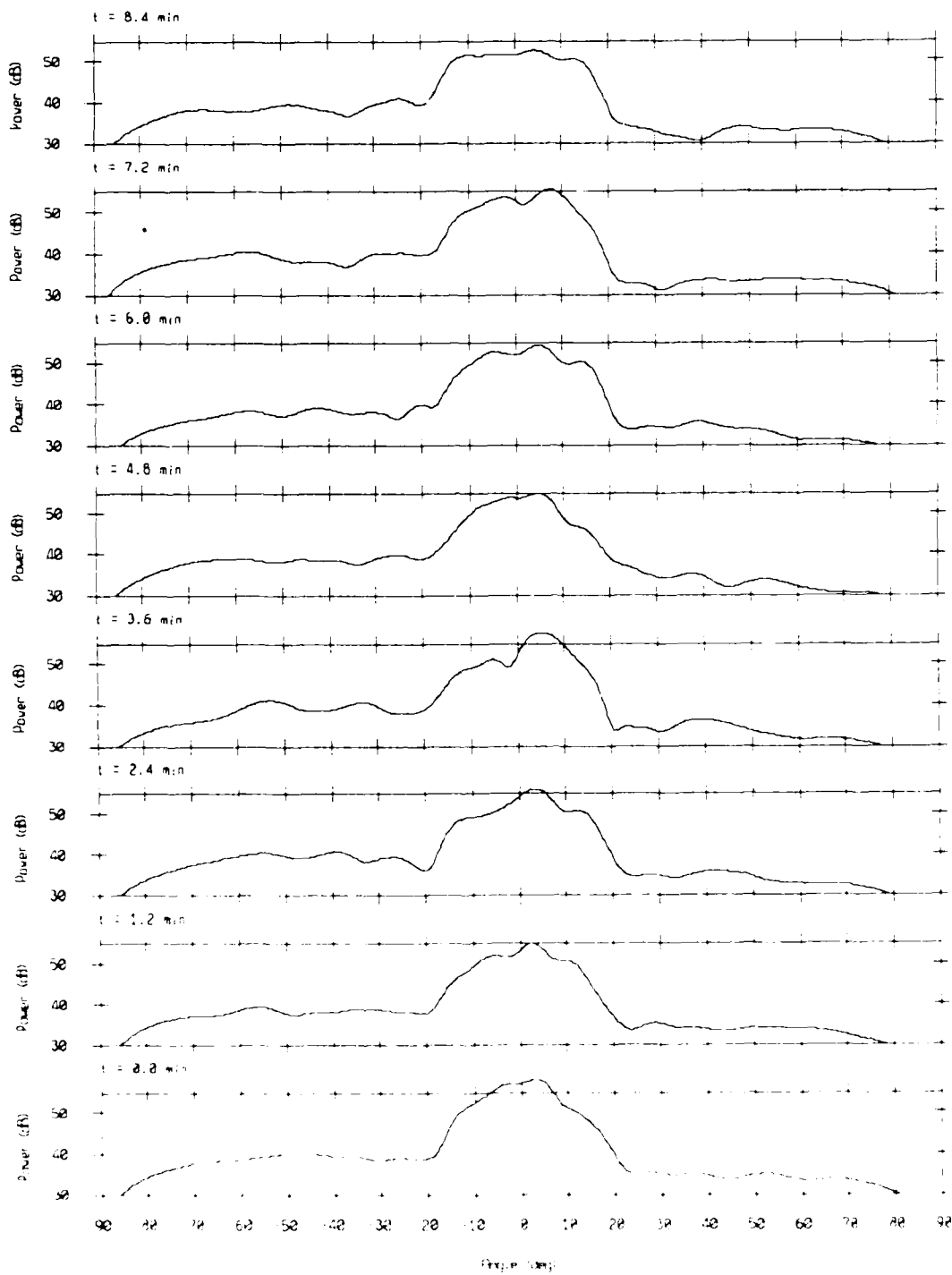
Array Response - 85010 Bin #5451

$f = 150$  Hz, KB window ( $\alpha = 1.5$ )



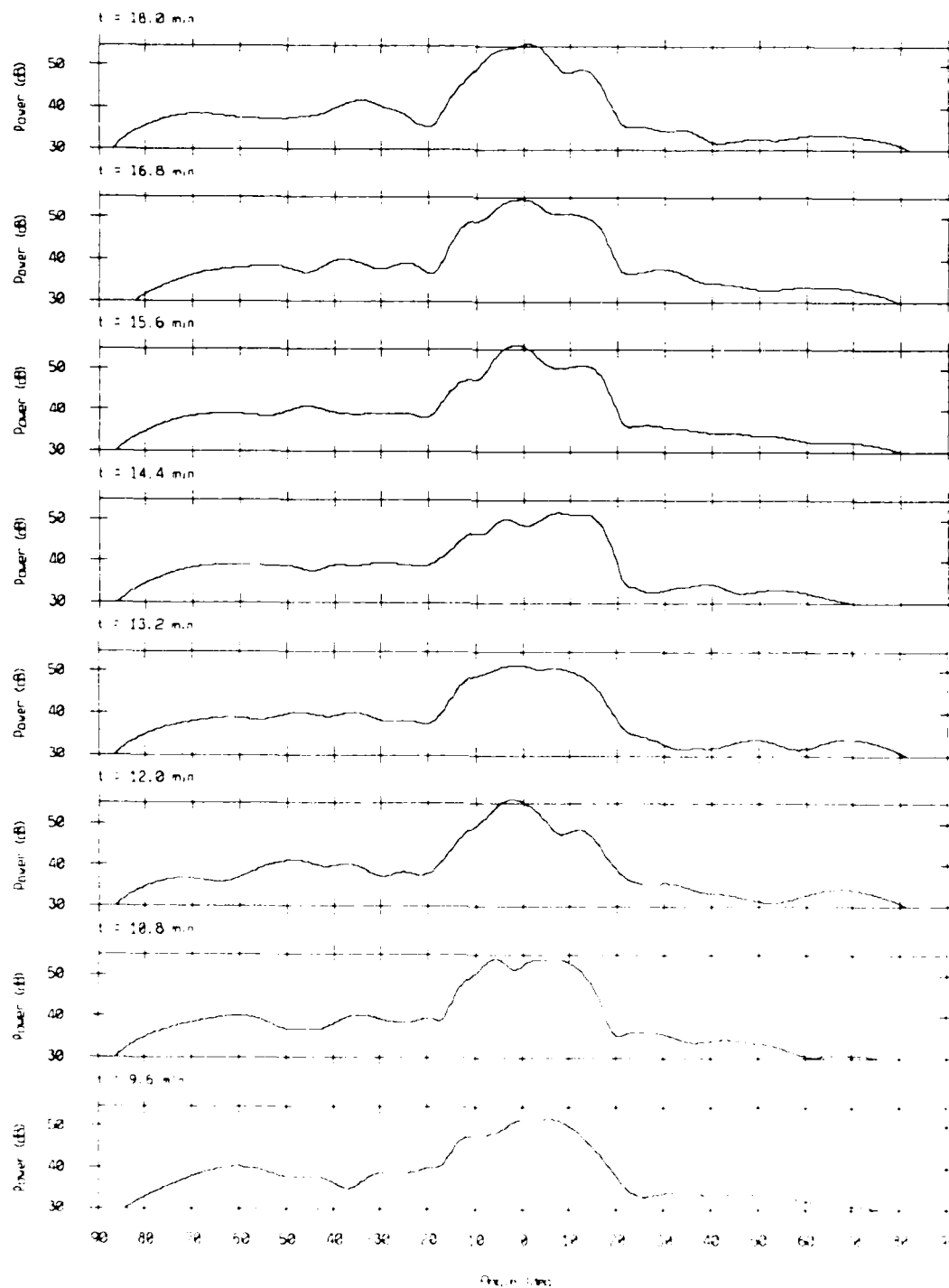
Array Response - 85010 Bin #5676

$f = 175$  Hz, KB window ( $\alpha = 1.5$ )



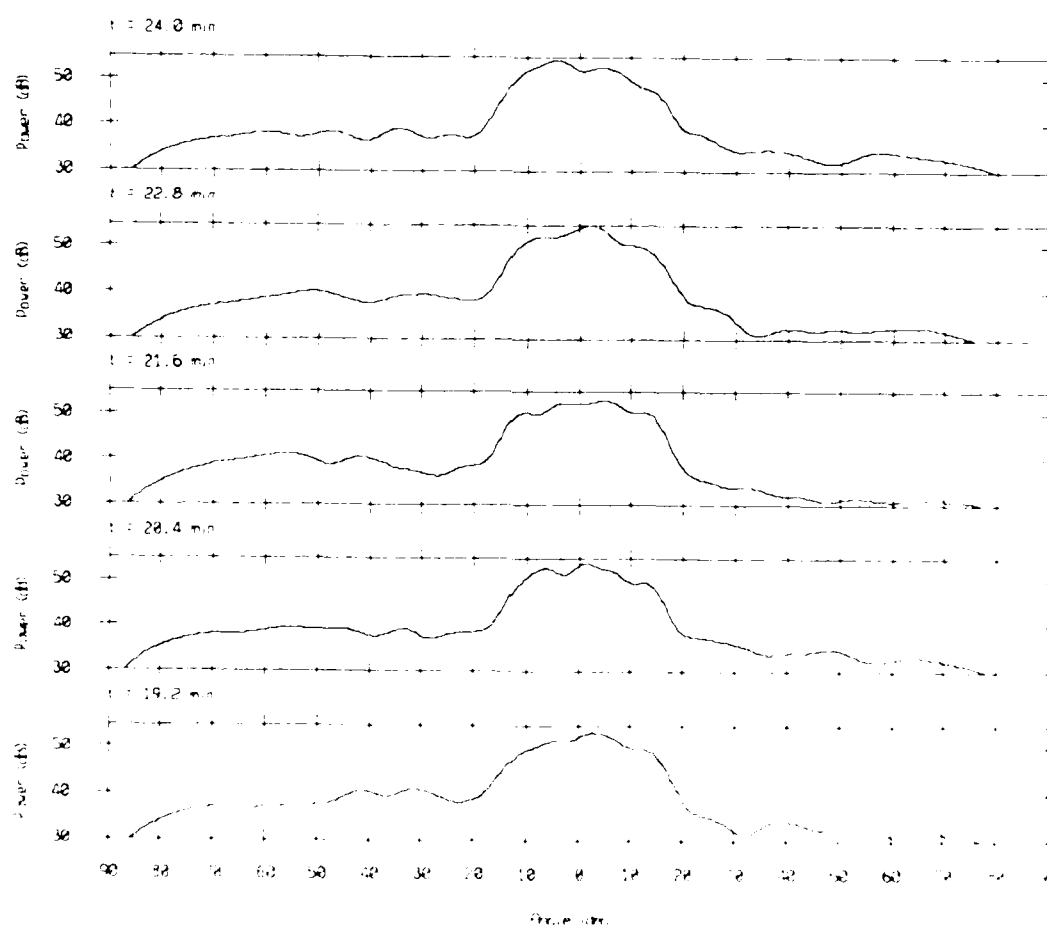
Array Response - 85010 3in #5676

$f = 175$  Hz, KB window (alpha = 1.5)



Energy Response - 85010 BIn #5676

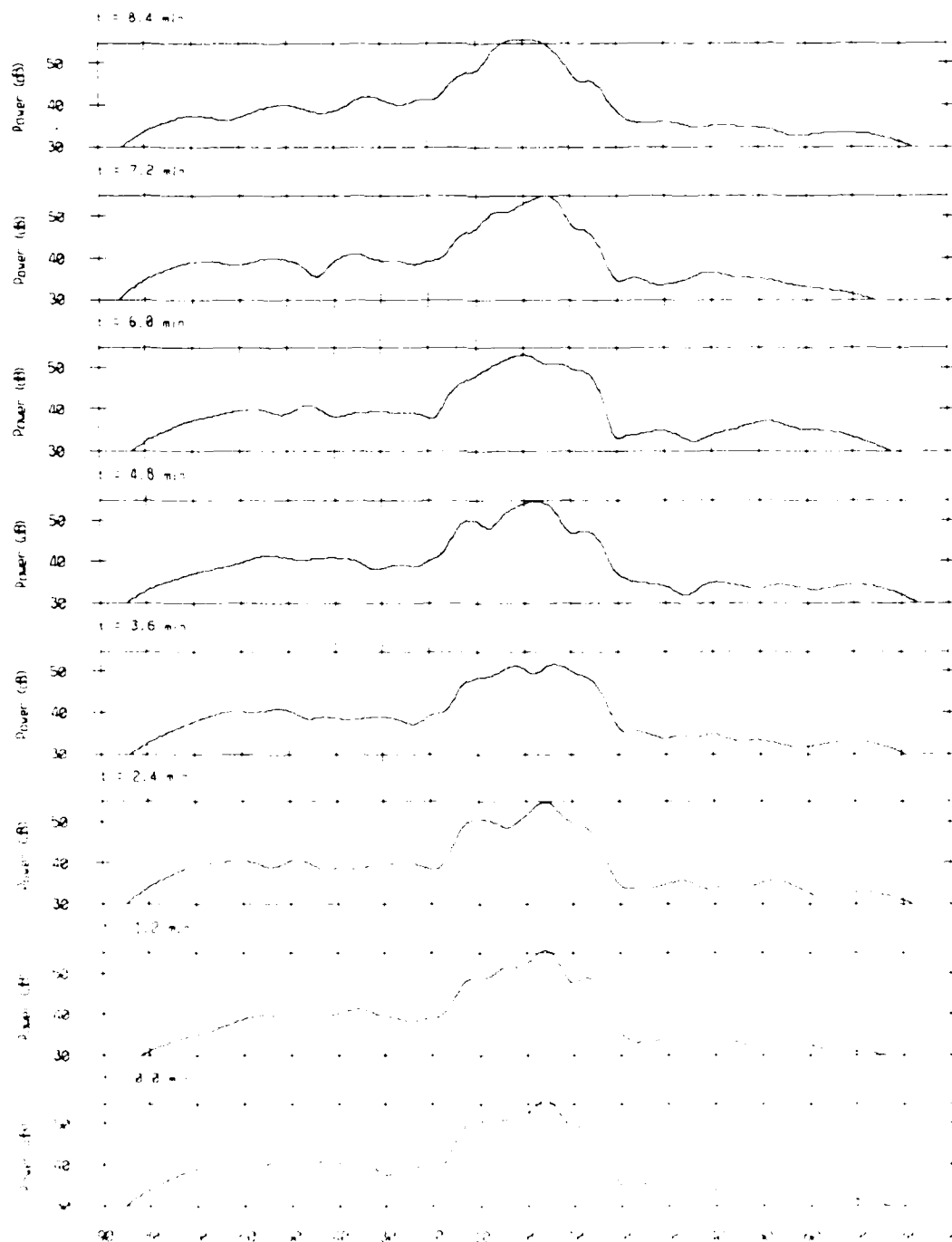
$f = 175$  Hz,  $\Delta B$  window (alpha = 1.5)





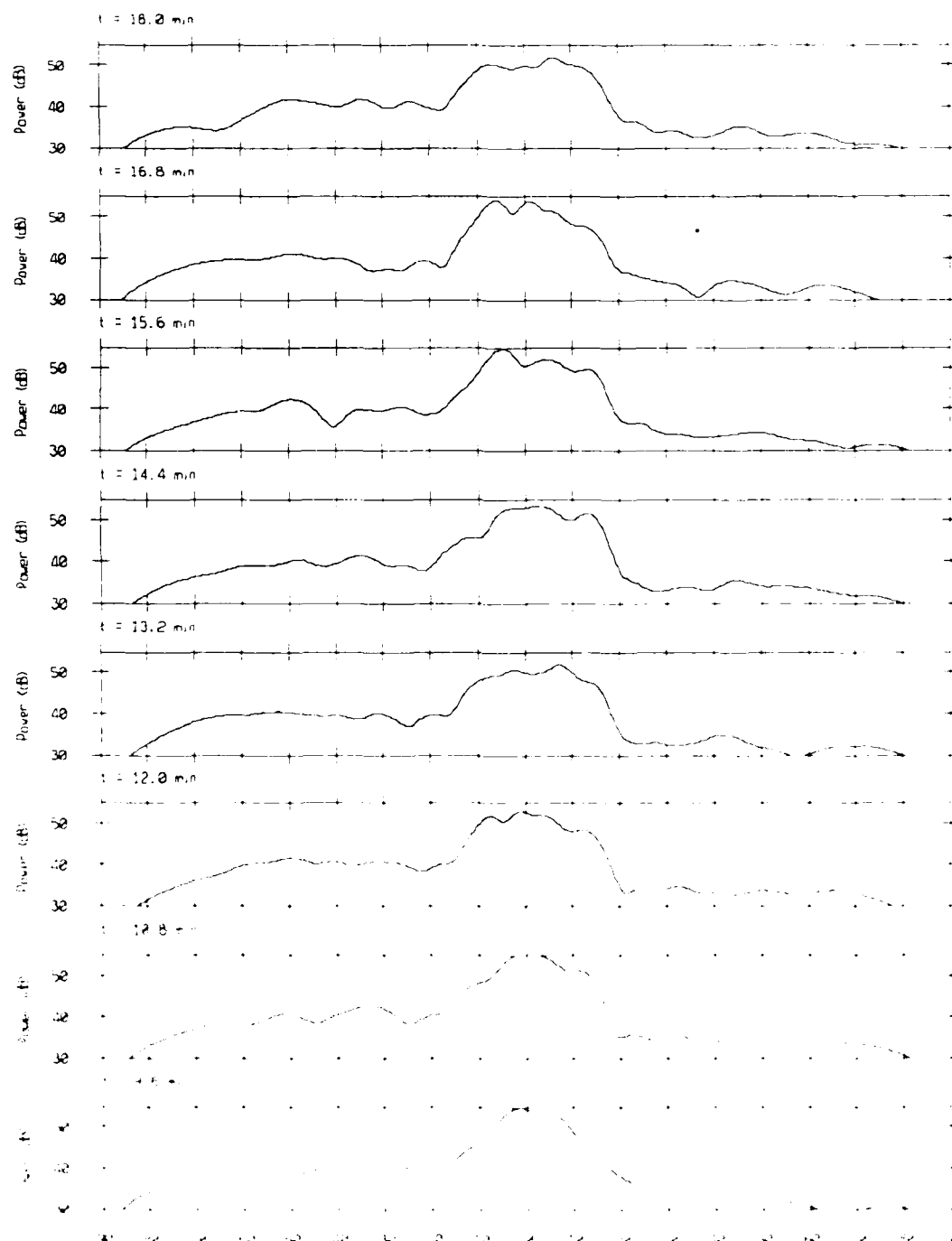
Binary Response - 85010 31r #5922

f = 200 Hz, K3 window (slope = 1.5)

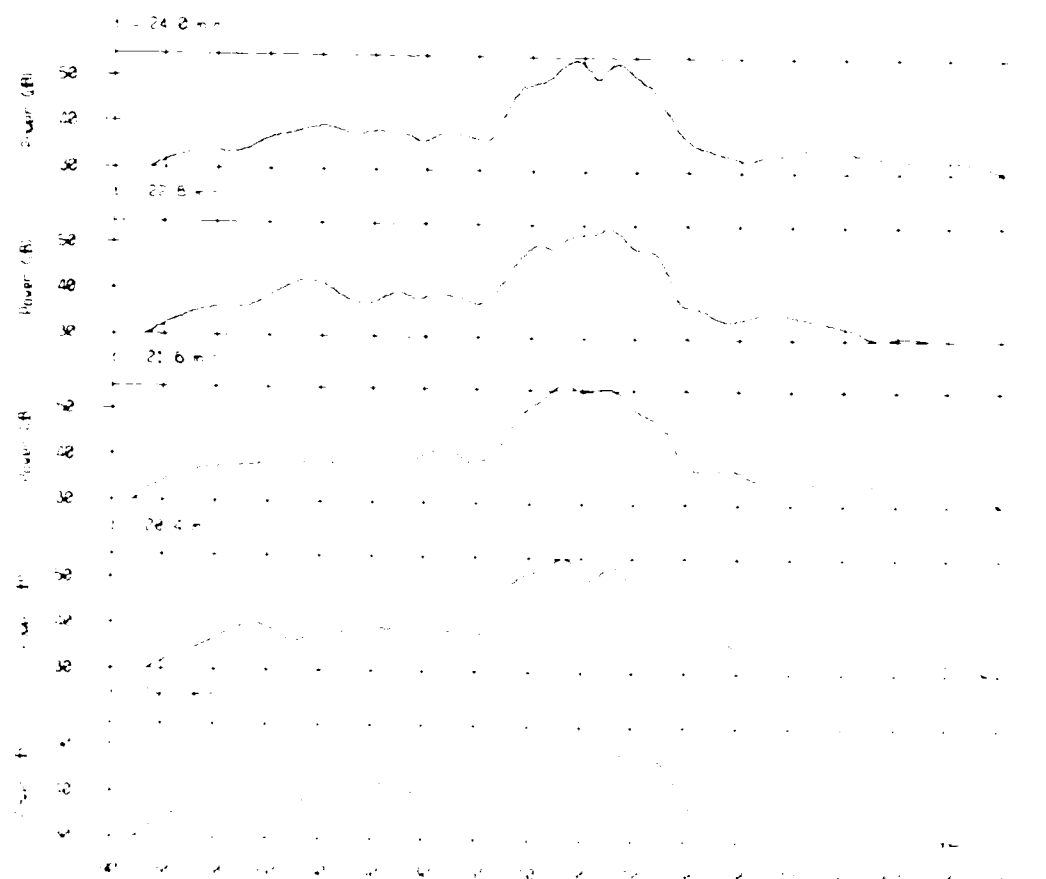


Proc. Response - 85010 Bin #5902

$f = 202$  Hz, KB window (alpha = 1.5)

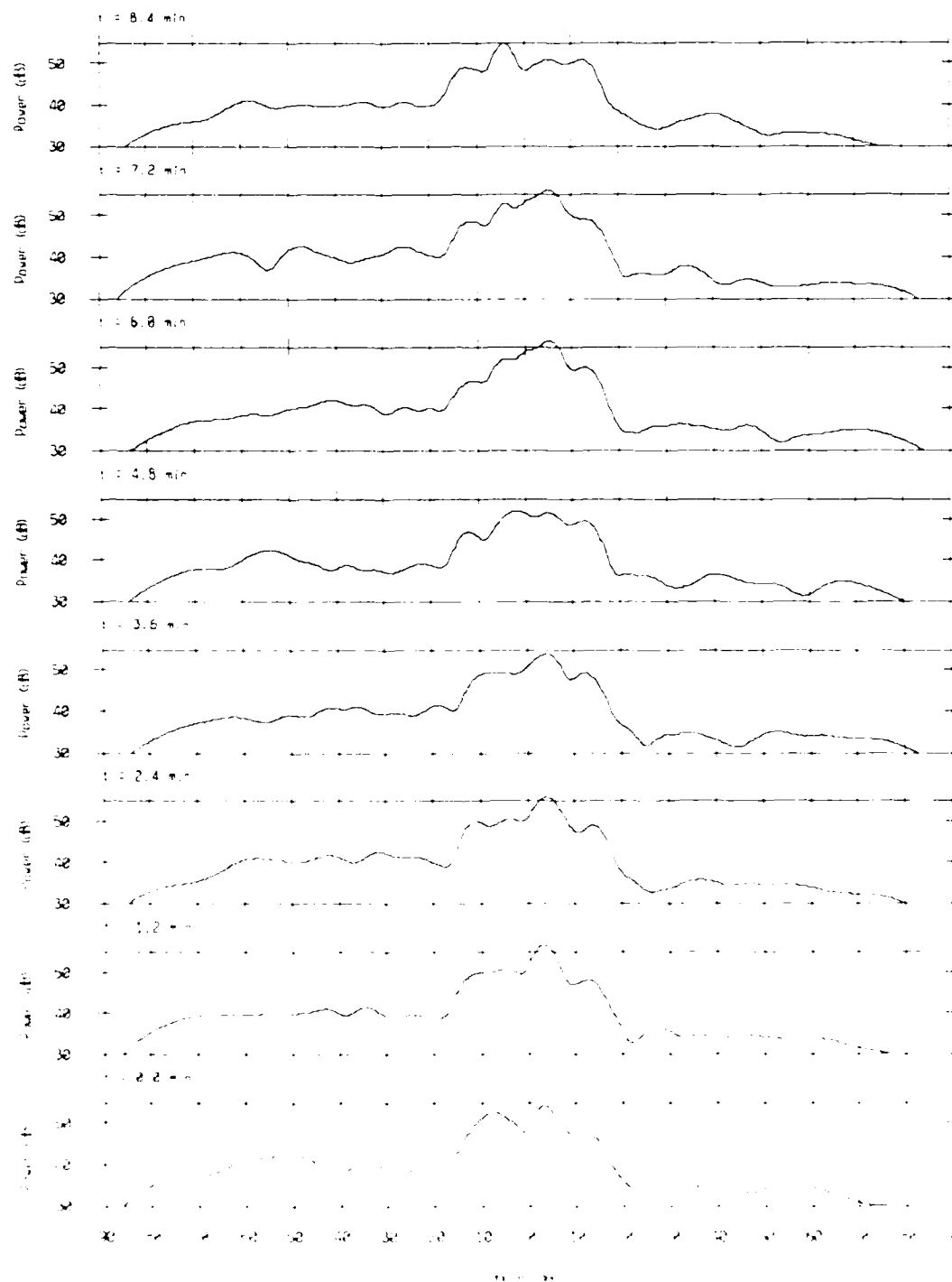


Array Response - 85012 Bin #5922  
 $f = 220$  Hz,  $\Delta f$  window (band) = 1 Hz



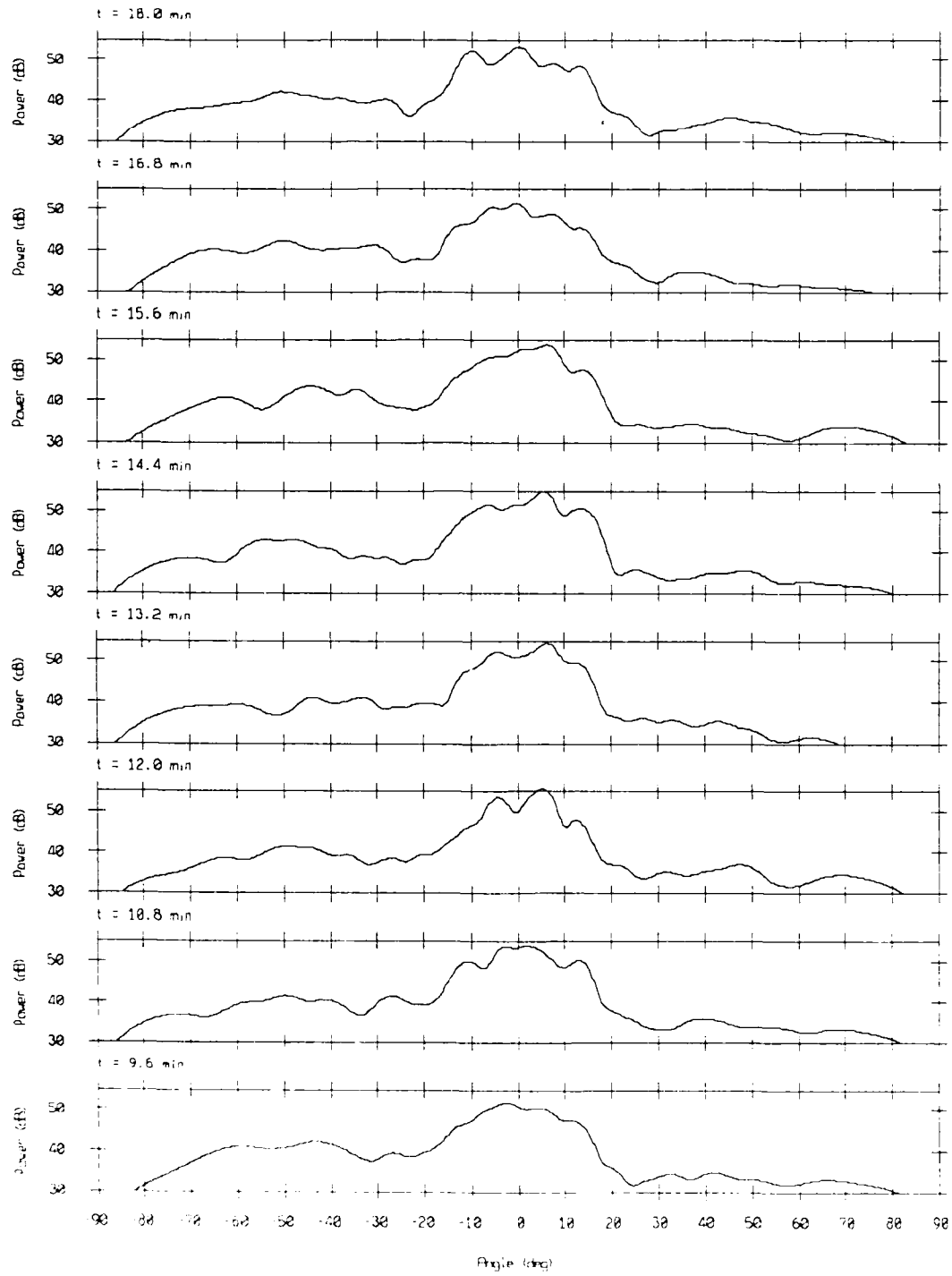
Array Response - 85010 Bin #6127

$f = 225$  Hz,  $\Delta B$  window (alpha = 1.5)

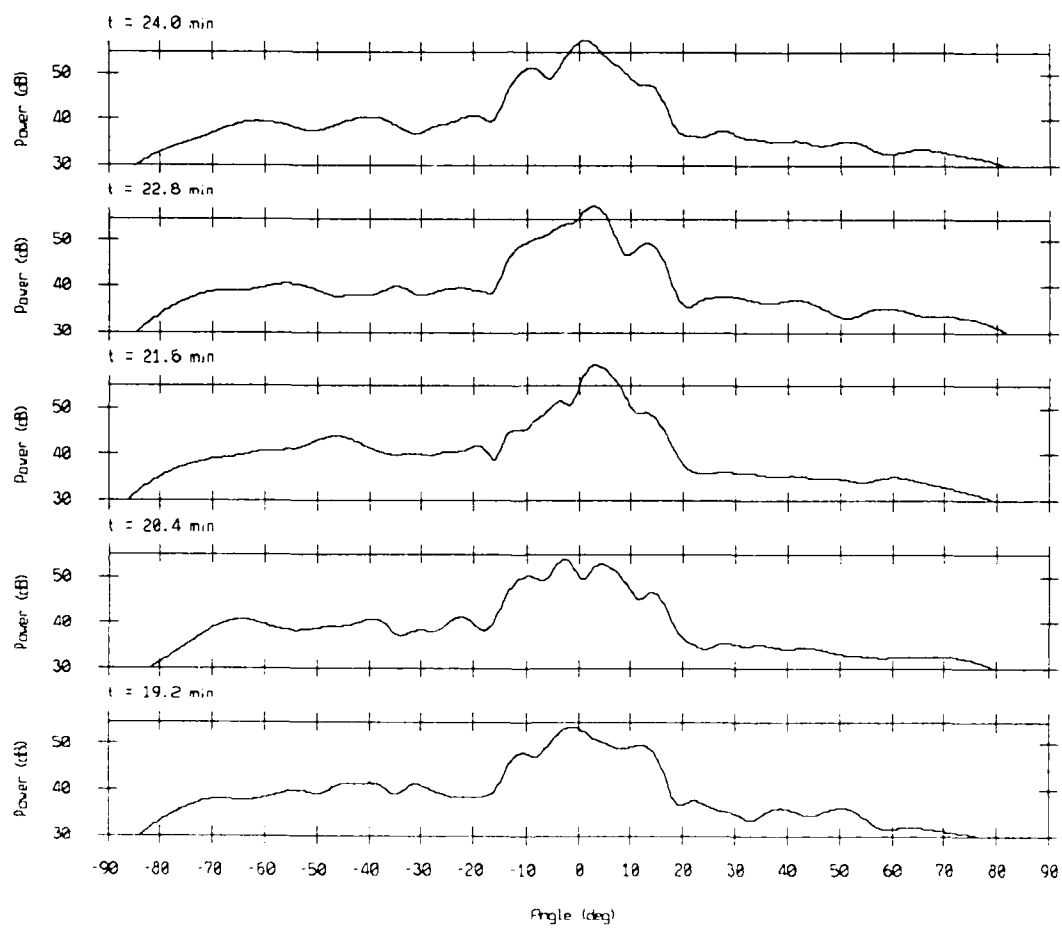


Array Response - 85010 Bin #6127

$f = 225$  Hz, KB window ( $\alpha = 1.5$ )

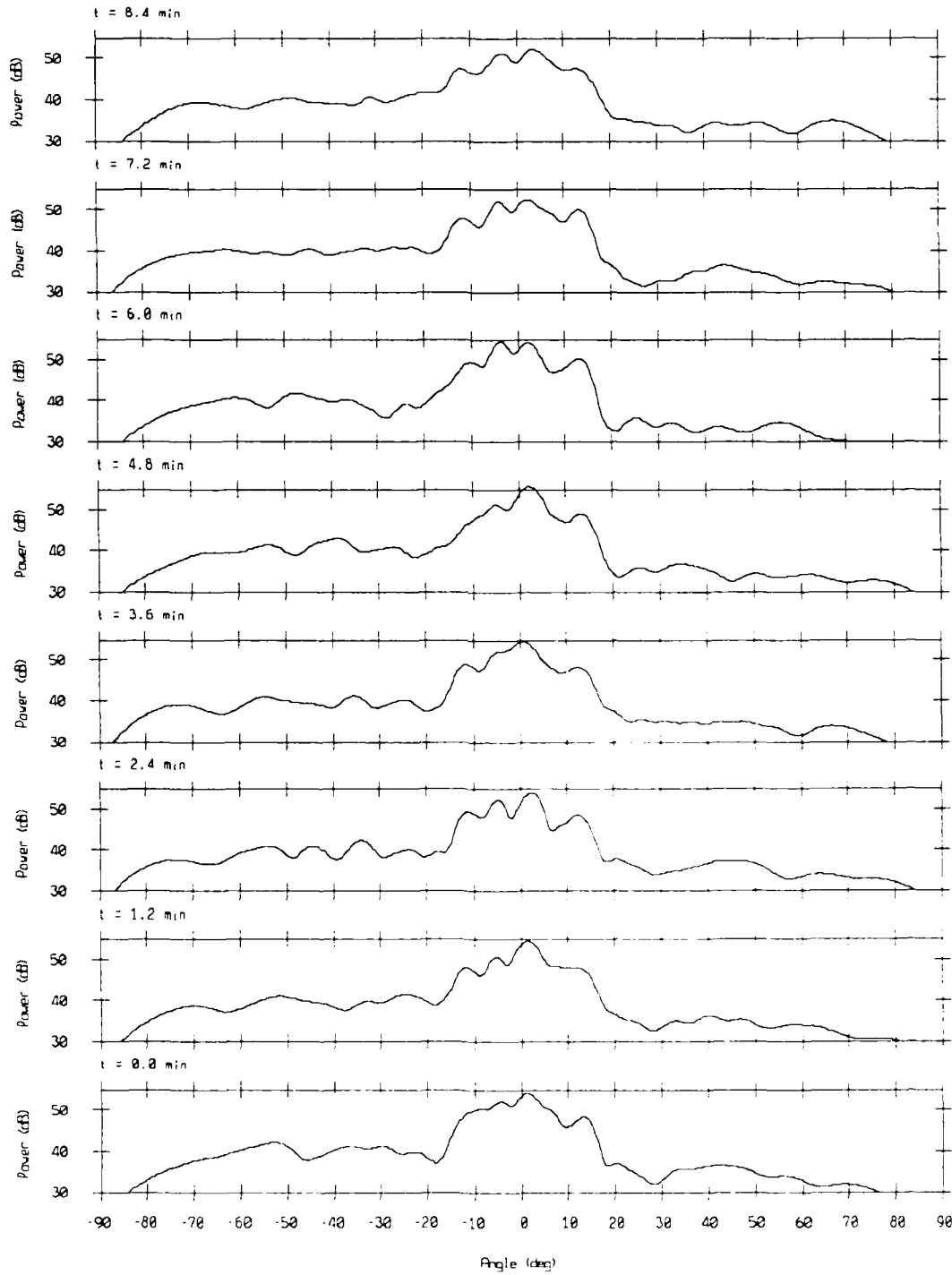


Array Response - 85010 Bin #6127  
 $f = 225$  Hz, KB window ( $\alpha = 1.5$ )



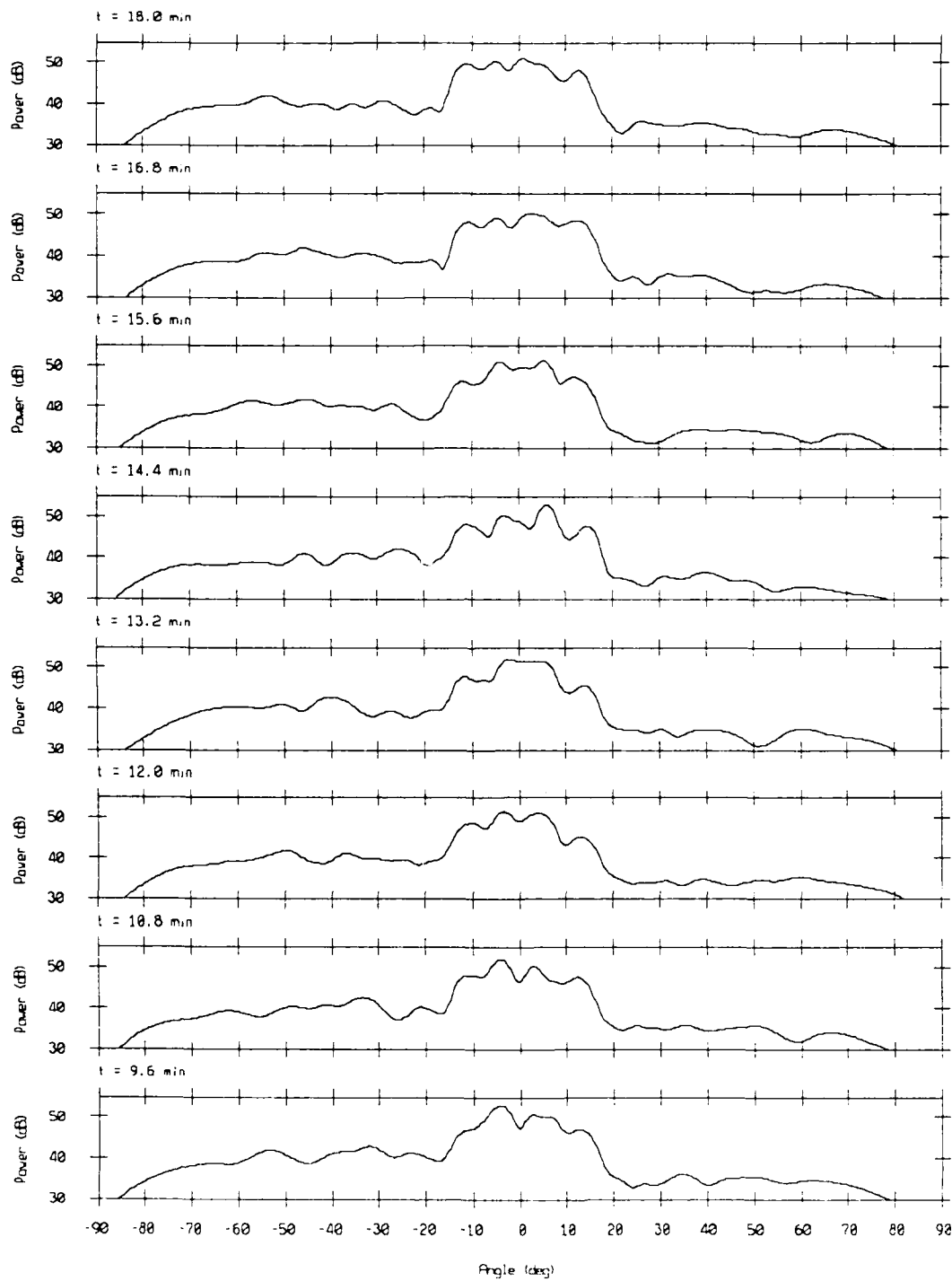
Array Response - 85010 Bin #6354

$f = 250$  Hz, KB window ( $\alpha = 1.5$ )



Array Response - 85010 Bin #6354

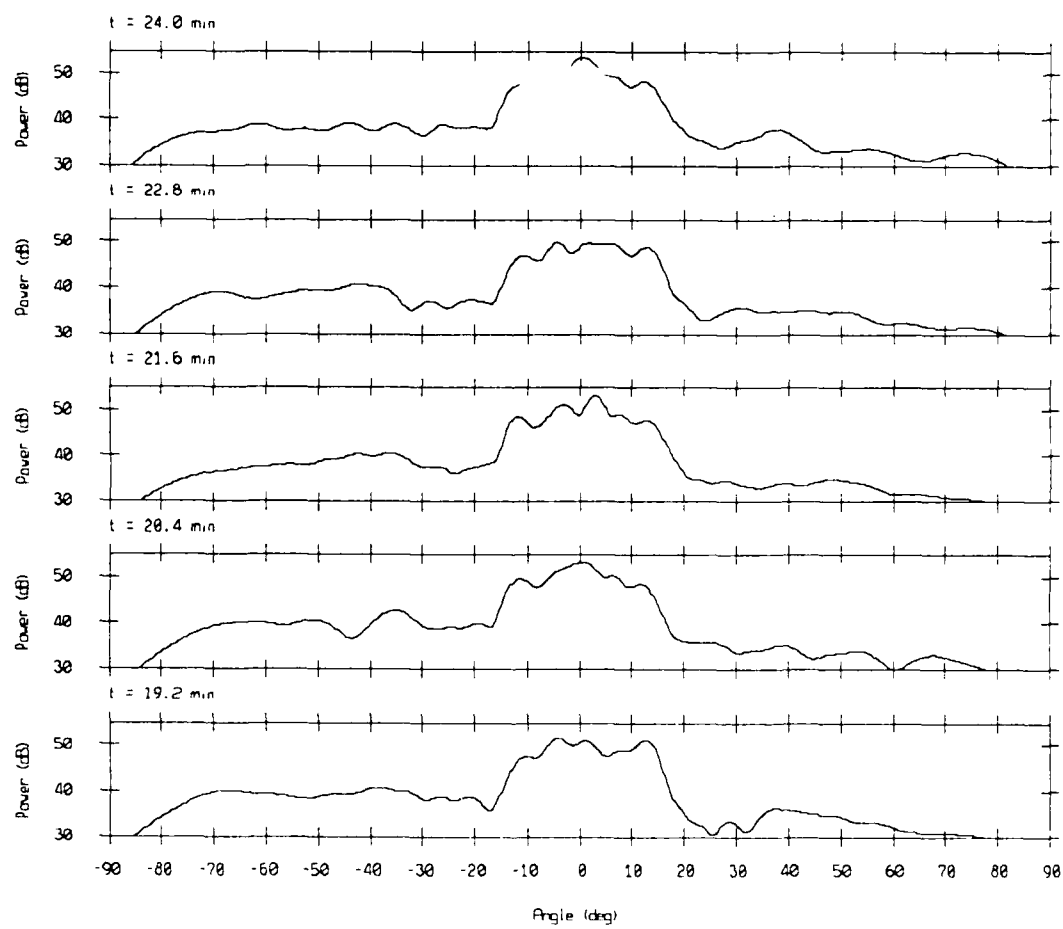
$f = 250$  Hz, KB window ( $\alpha = 1.5$ )





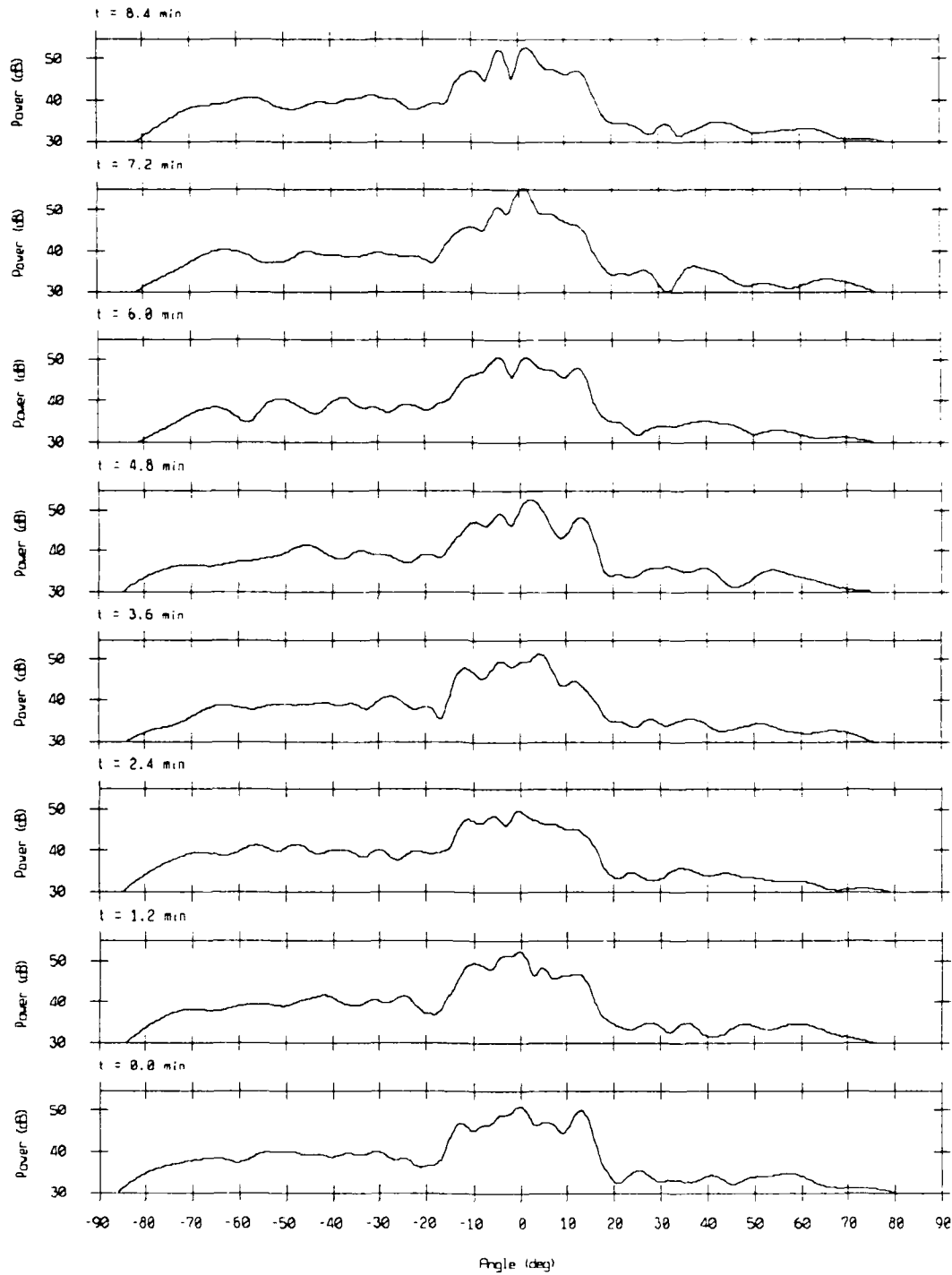
Array Response - 85010 Bin #6354

$f = 250$  Hz, KB window ( $\alpha = 1.5$ )



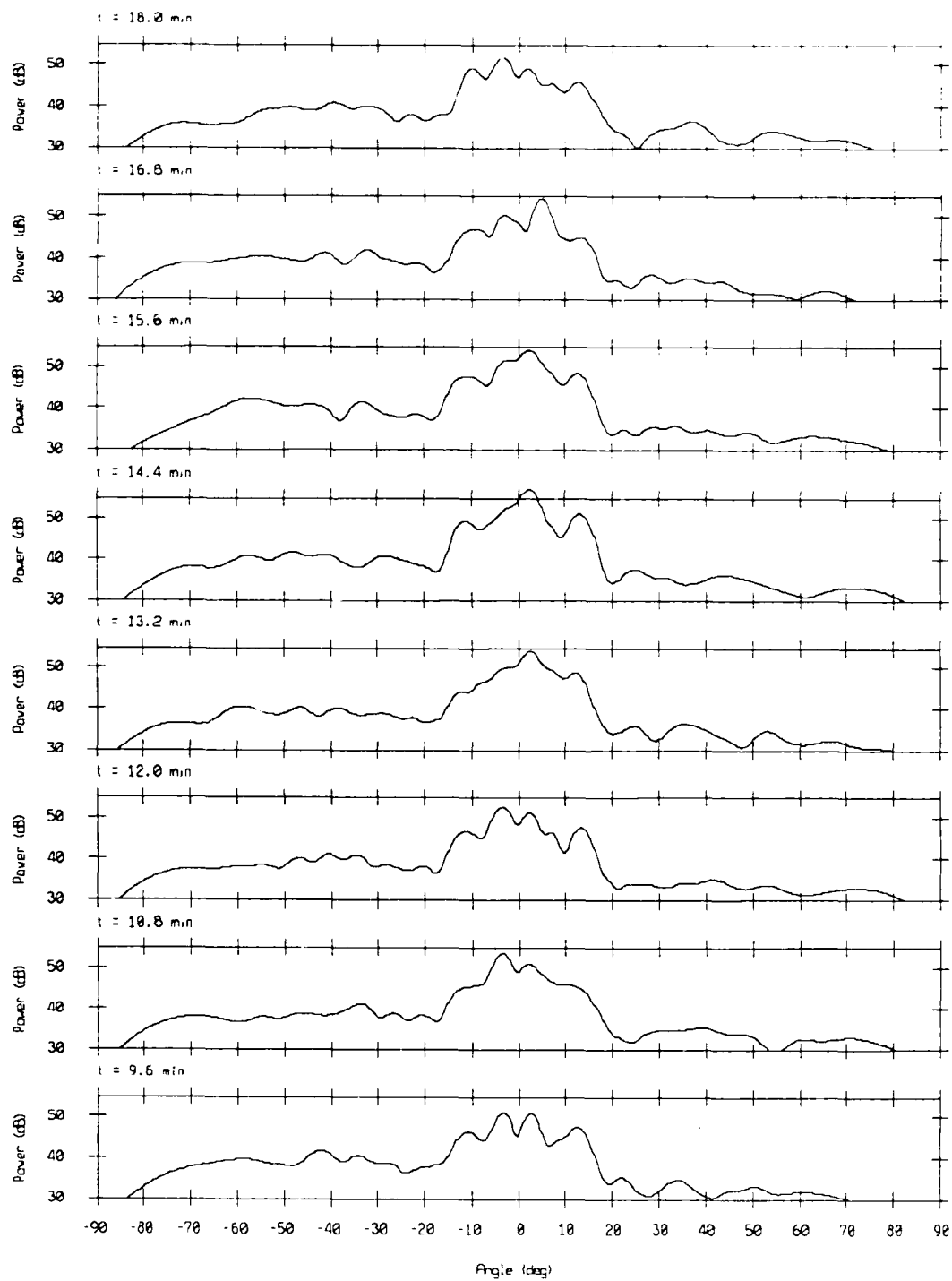
Array Response - 85010 Bin #6579

$f = 275$  Hz, KB window (alpha = 1.5)



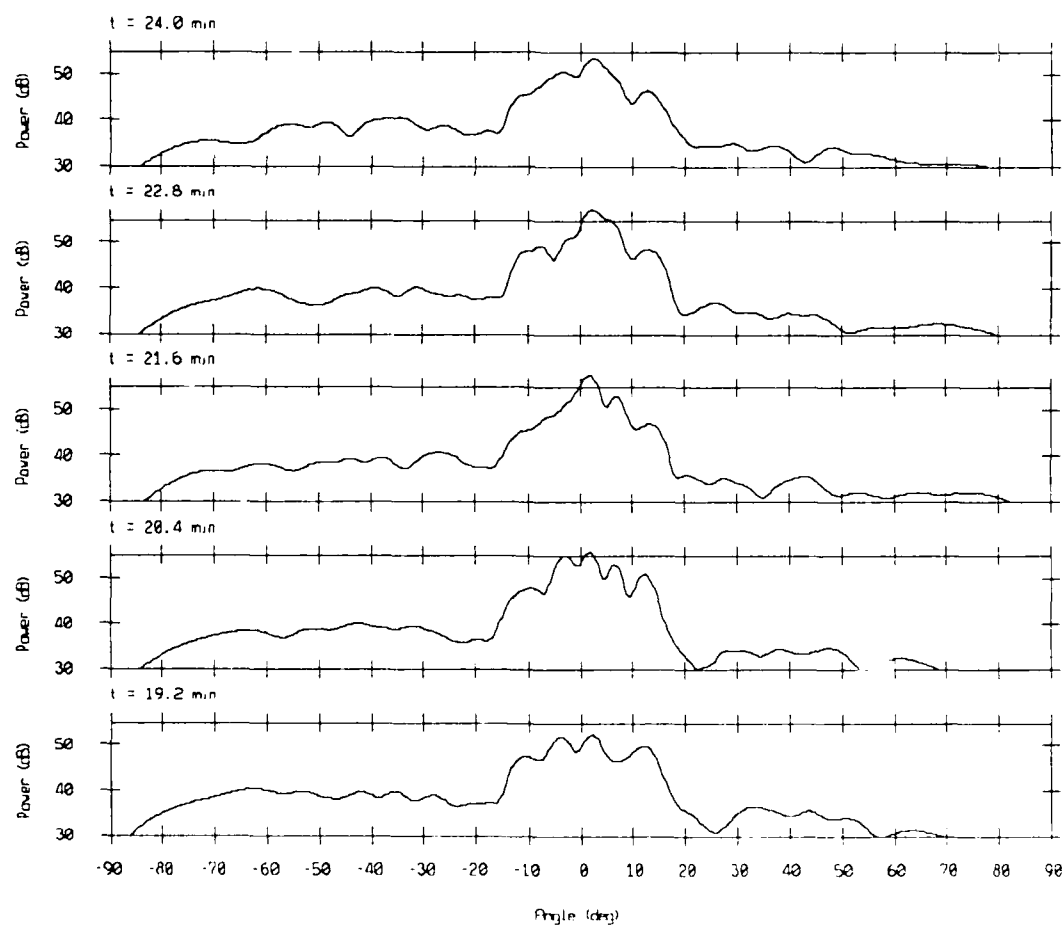
Array Response - 85010 Bin #6579

$f = 275$  Hz, KB window ( $\alpha = 1.5$ )



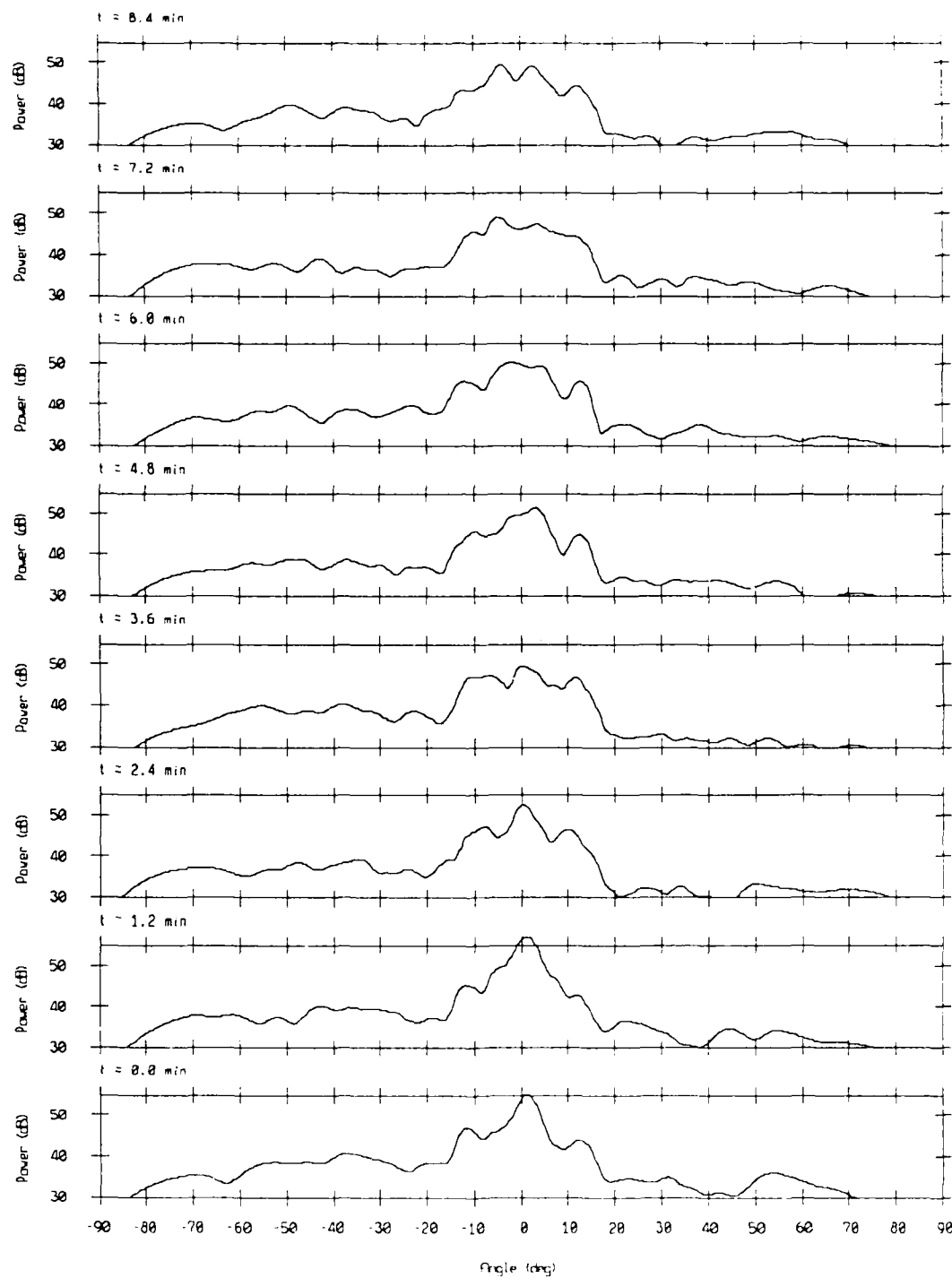
Array Response - 85010 Bin #6579

$f = 275$  Hz, KB window ( $\alpha = 1.5$ )



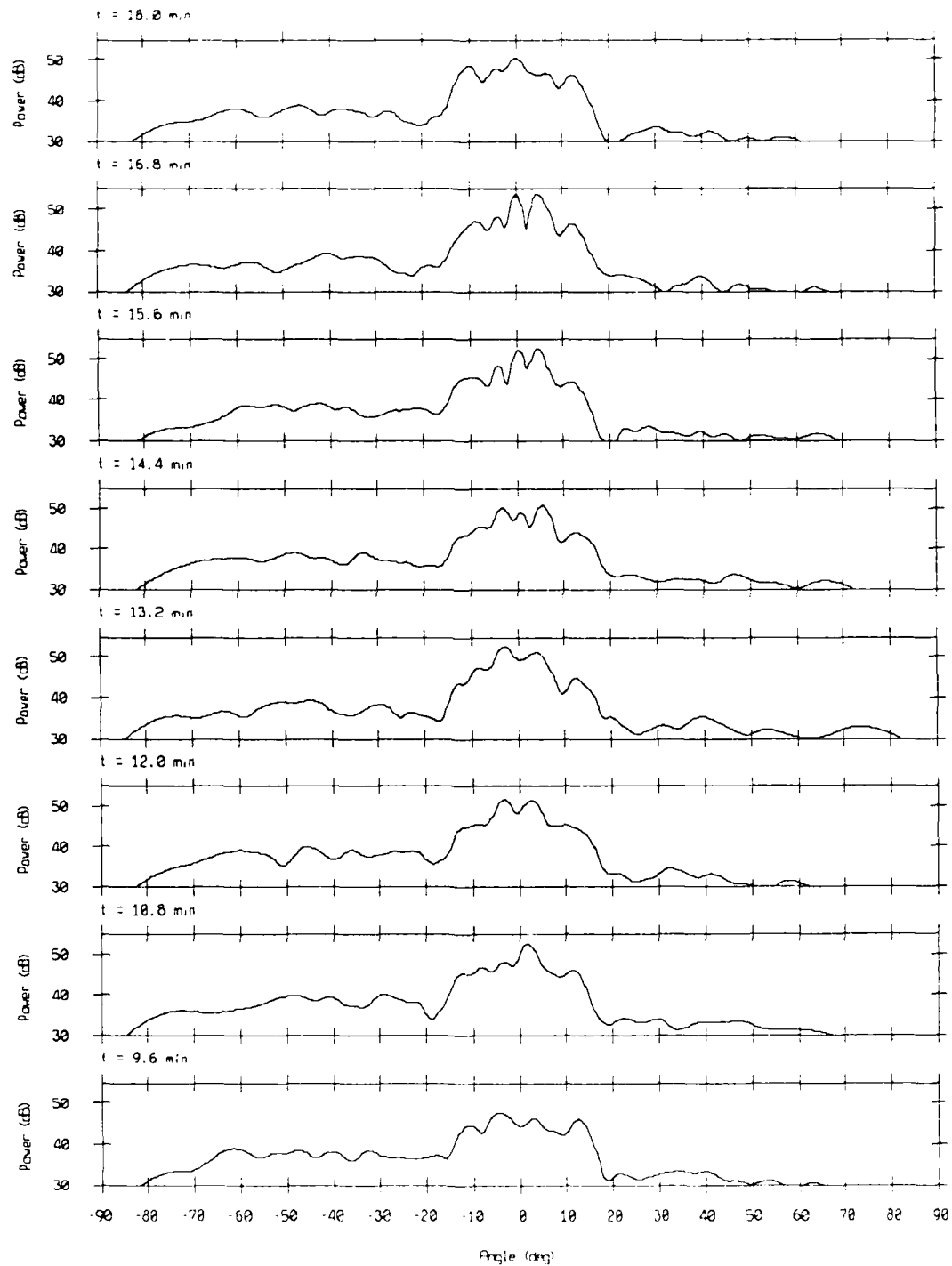
Array Response - 85010 Bin #6804

$f = 300$  Hz,  $\Delta B$  window ( $\alpha = 1.5$ )



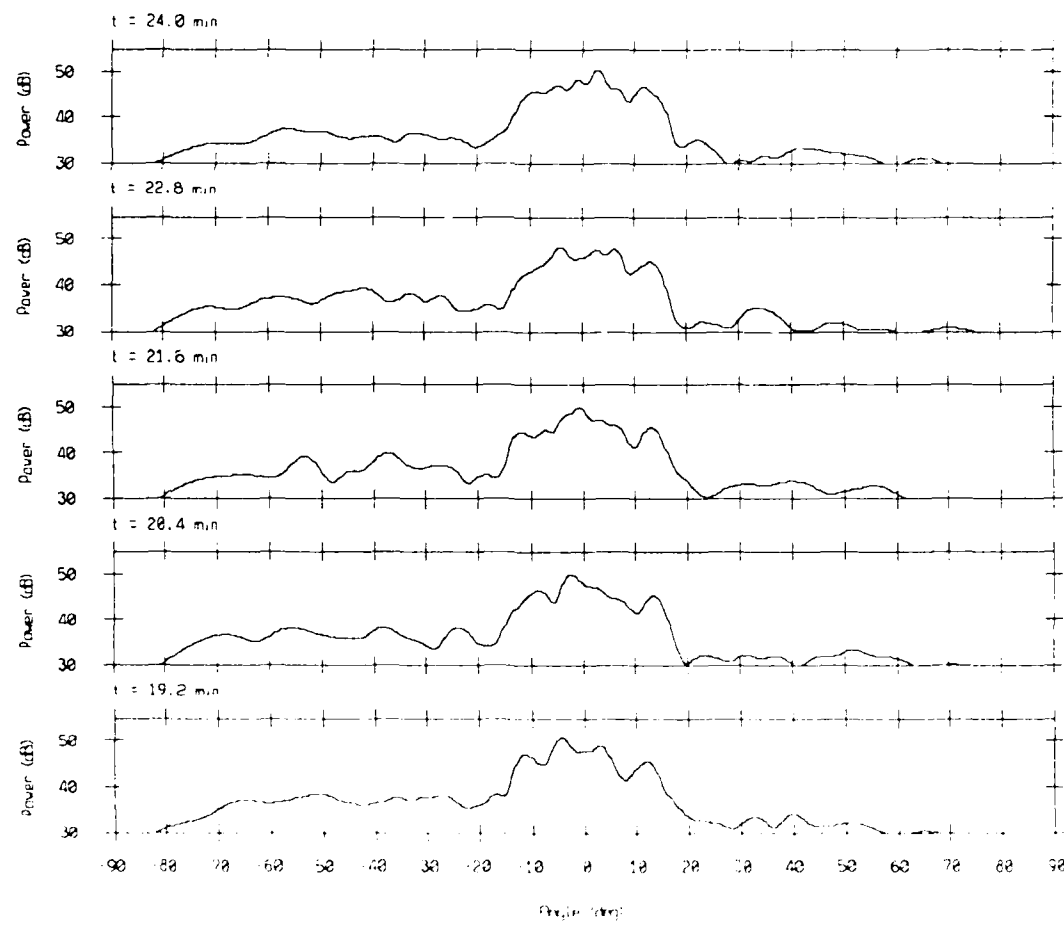
Array Response - 85010 Bin #6804

$f = 300$  Hz, KB window (alpha = 1.5)



Array Response - 85010 Bin #0824

$f = 320$  Hz, K5 window (alpha = 1.5)

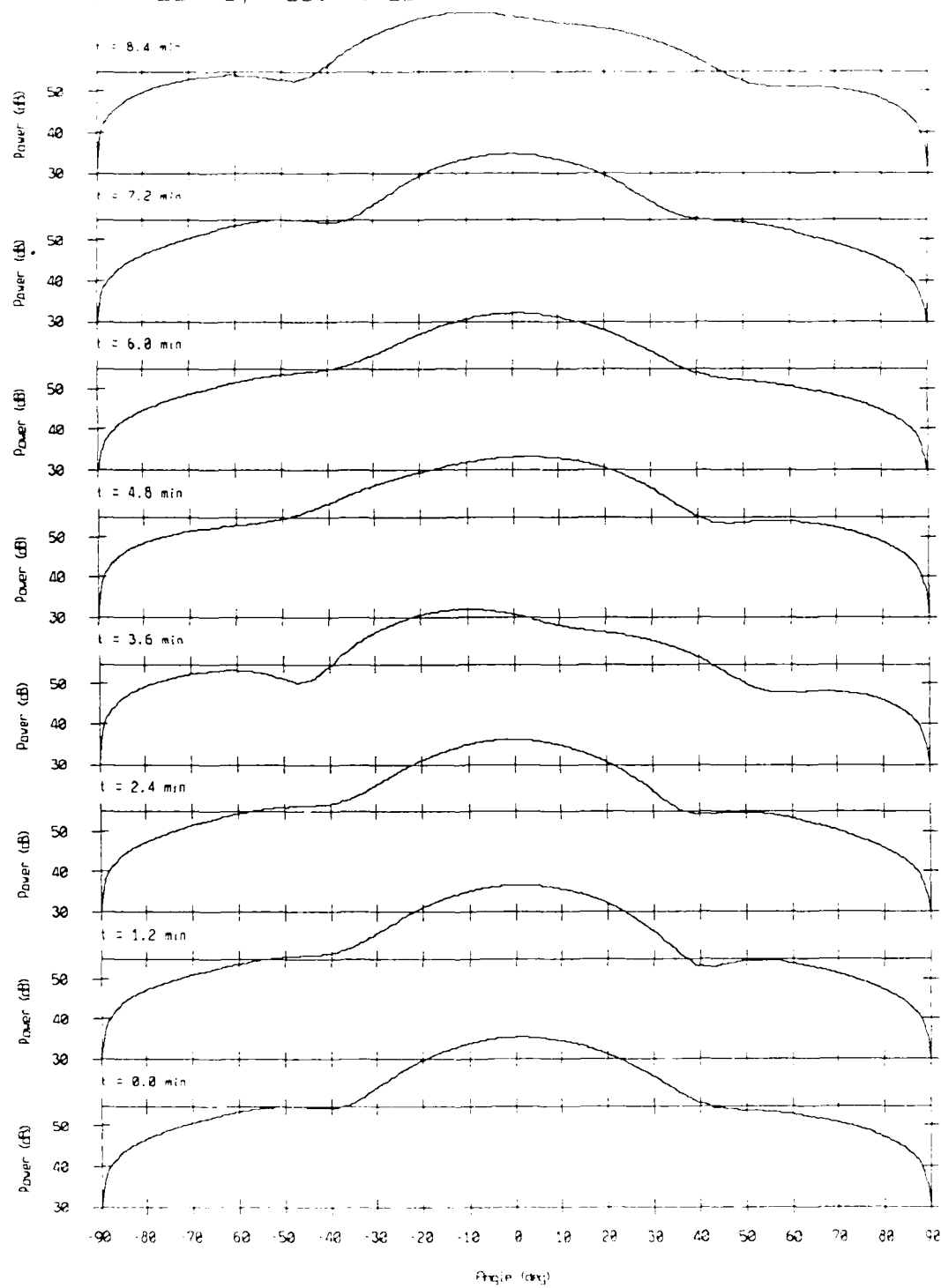


## VII. Array Response: Panels, Rect Window.



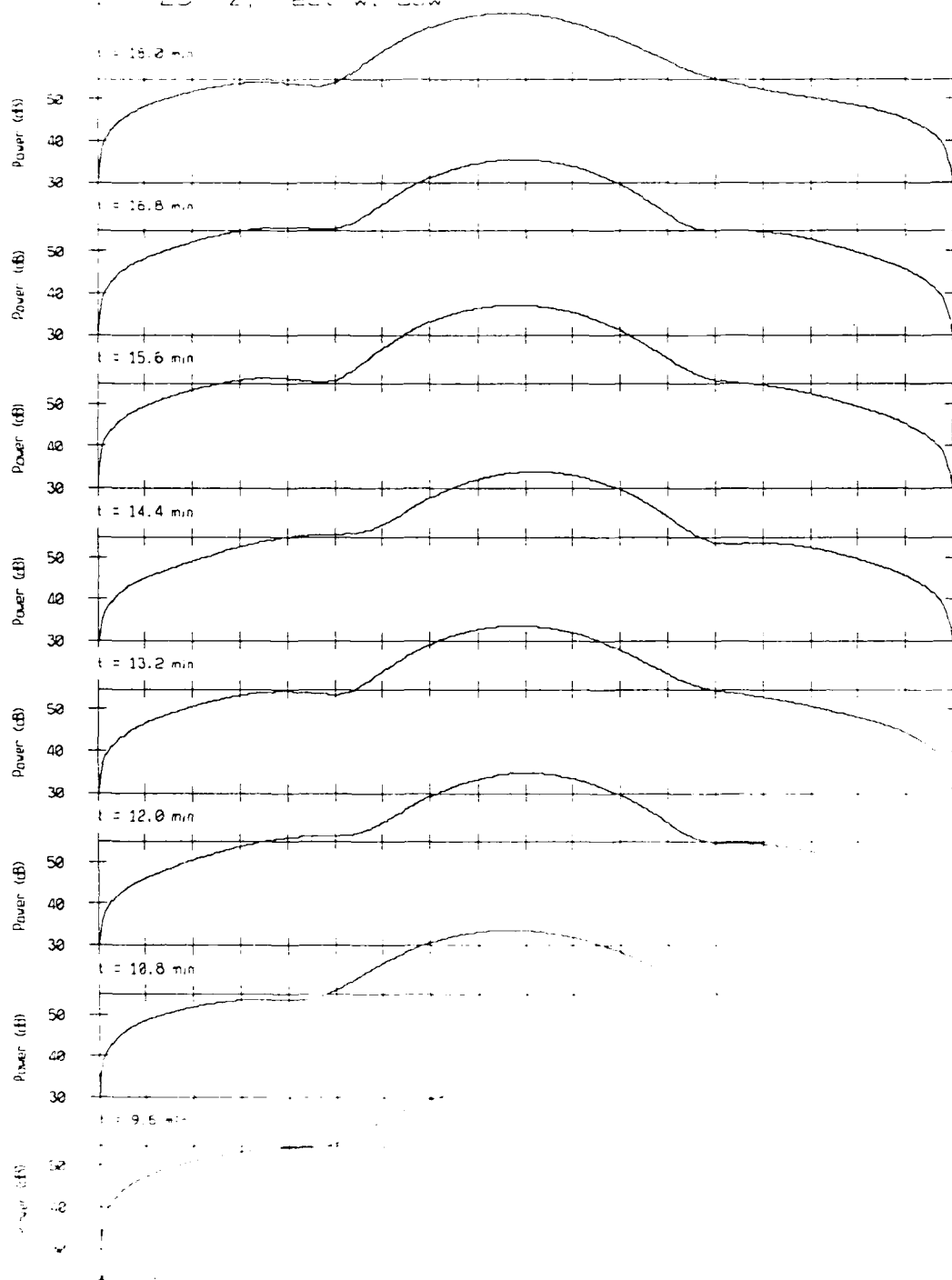
Pinch Response 85012 3/1 #4373

$f = 25$  Hz, rect window

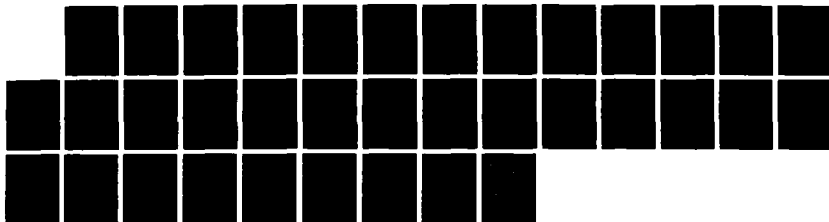


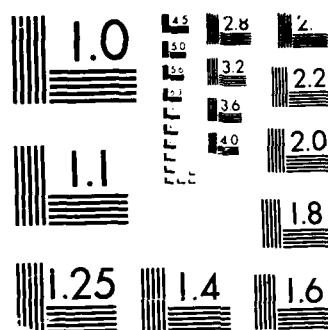
Grating Response - 85010 314 #4323

$f = 25$  Hz, rect window



AD-A193 231 VERTICAL DIRECTIONALITY OF AMBIENT NOISE AT 32 DEG N AS 2/2  
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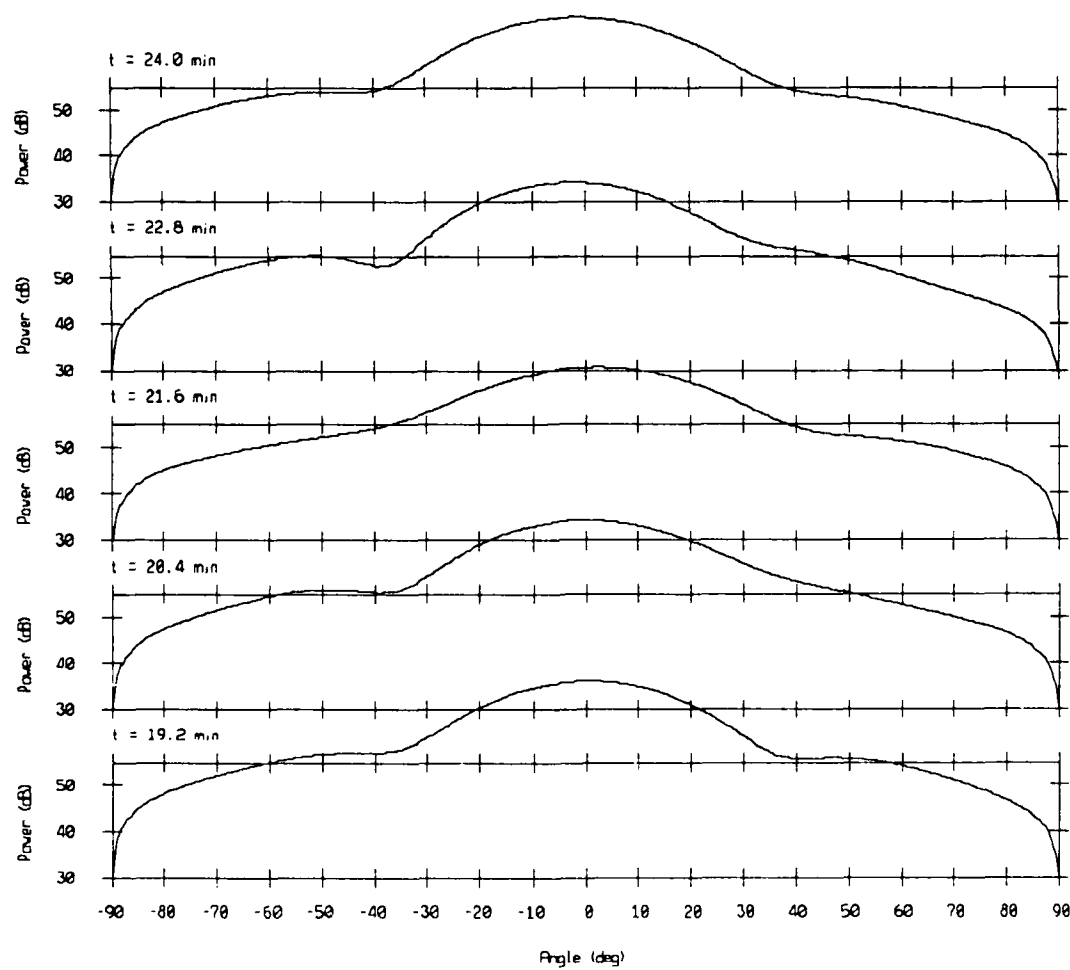


MICROCOPY RESOLUTION TEST CHART

STANDARD - Q61.2

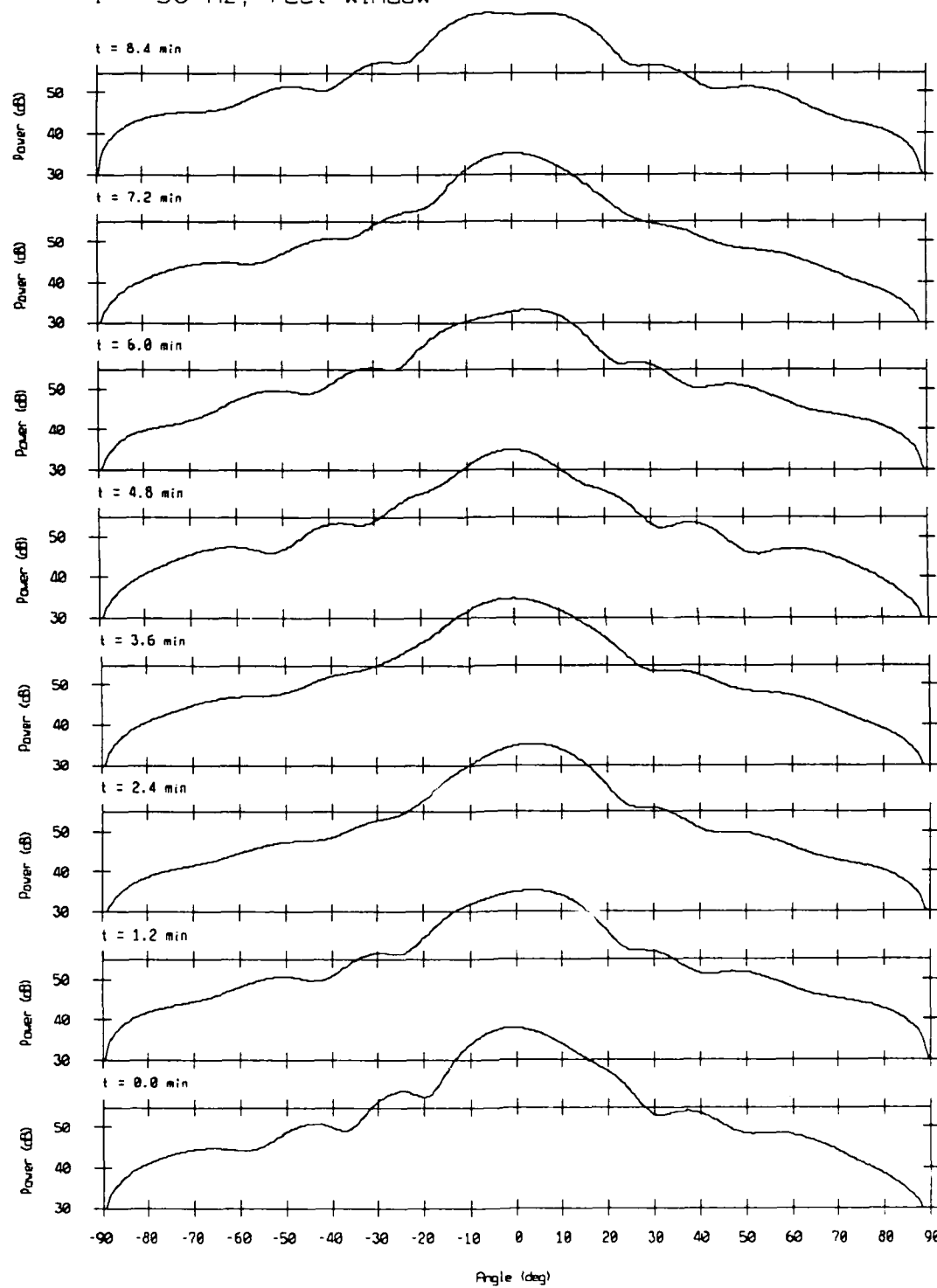
Array Response - 85010 Bin #4323

$f = 25$  Hz, rect window



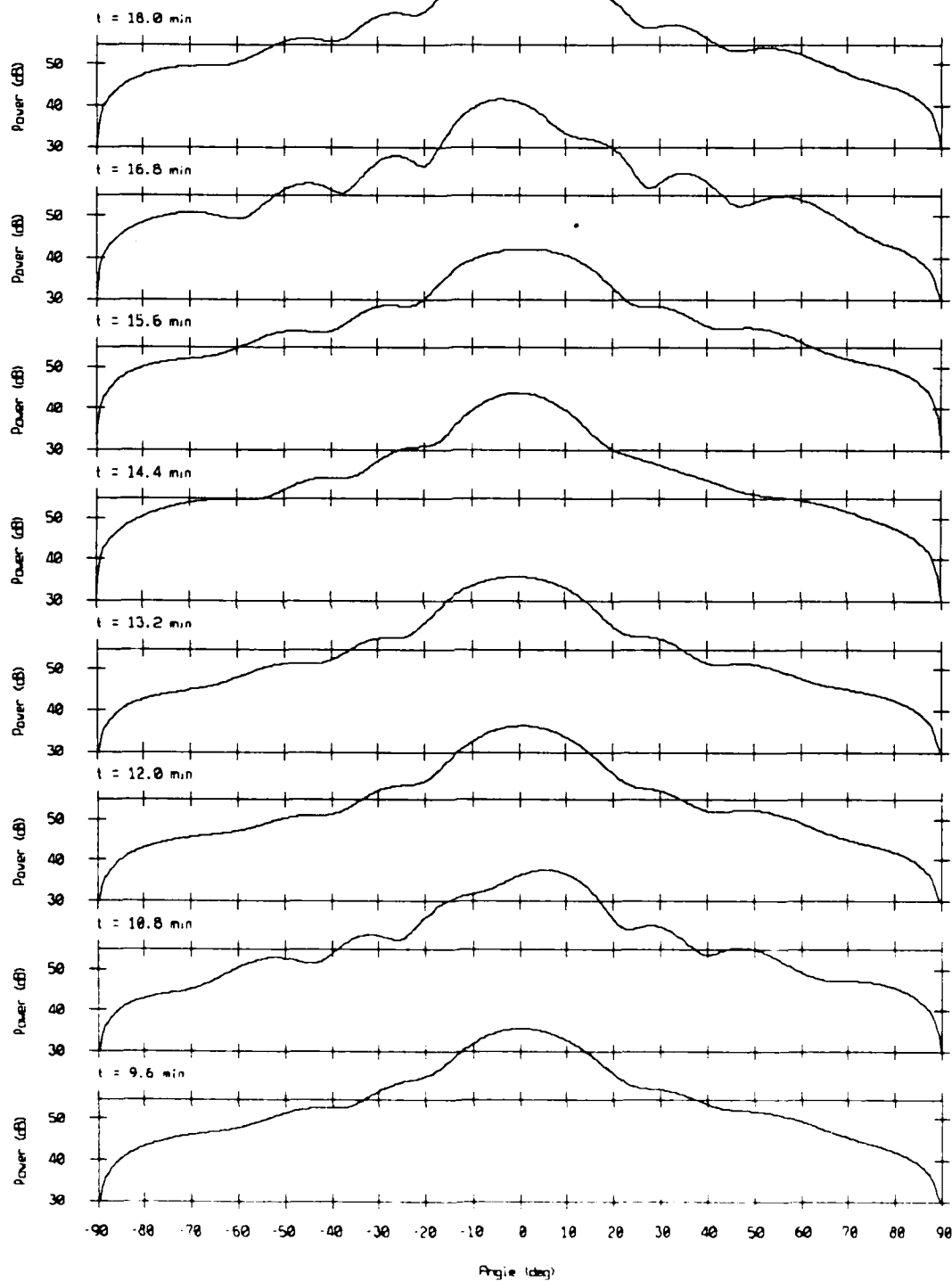
Array Response - 85010 Bin #4548

$f = 50$  Hz, rect window



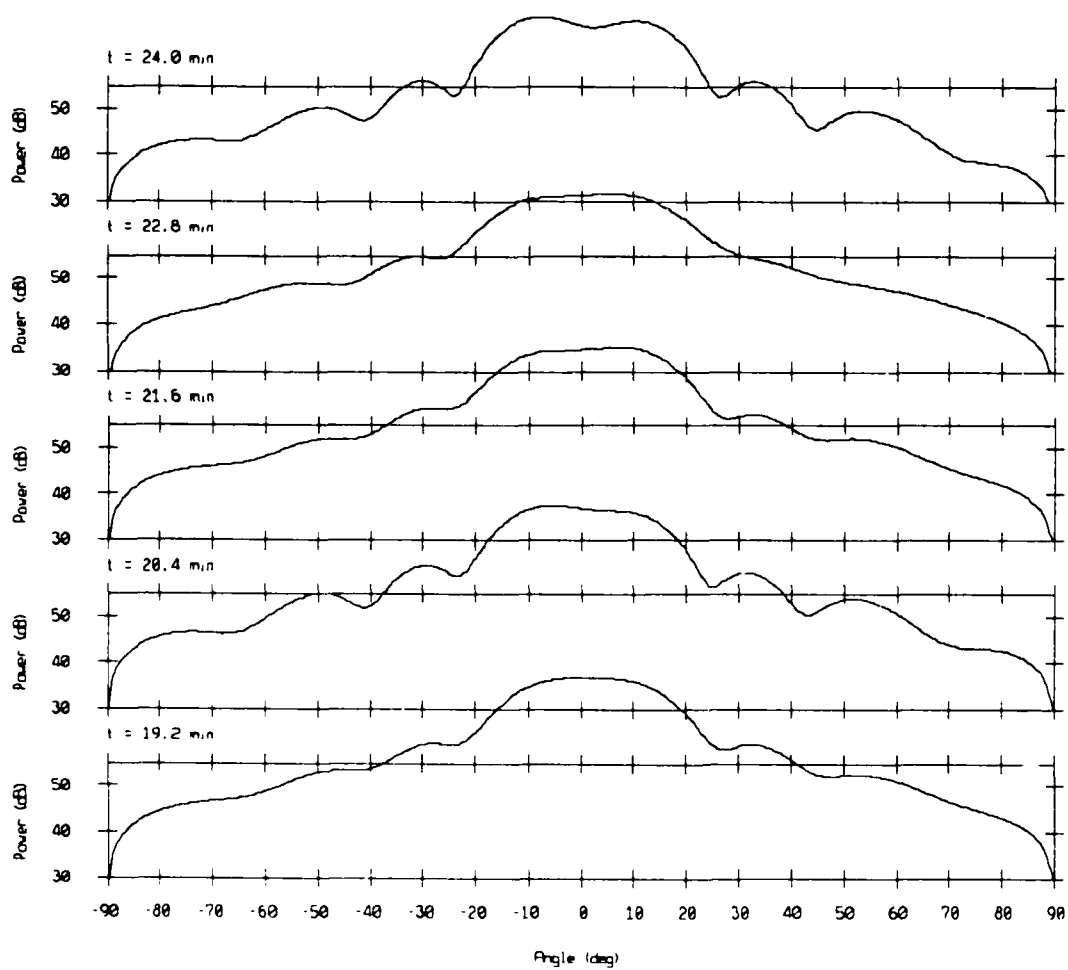
Array Response - 85010 Bin #4548

$f = 50$  Hz, rect window



Array Response - 85010 Bin #4548

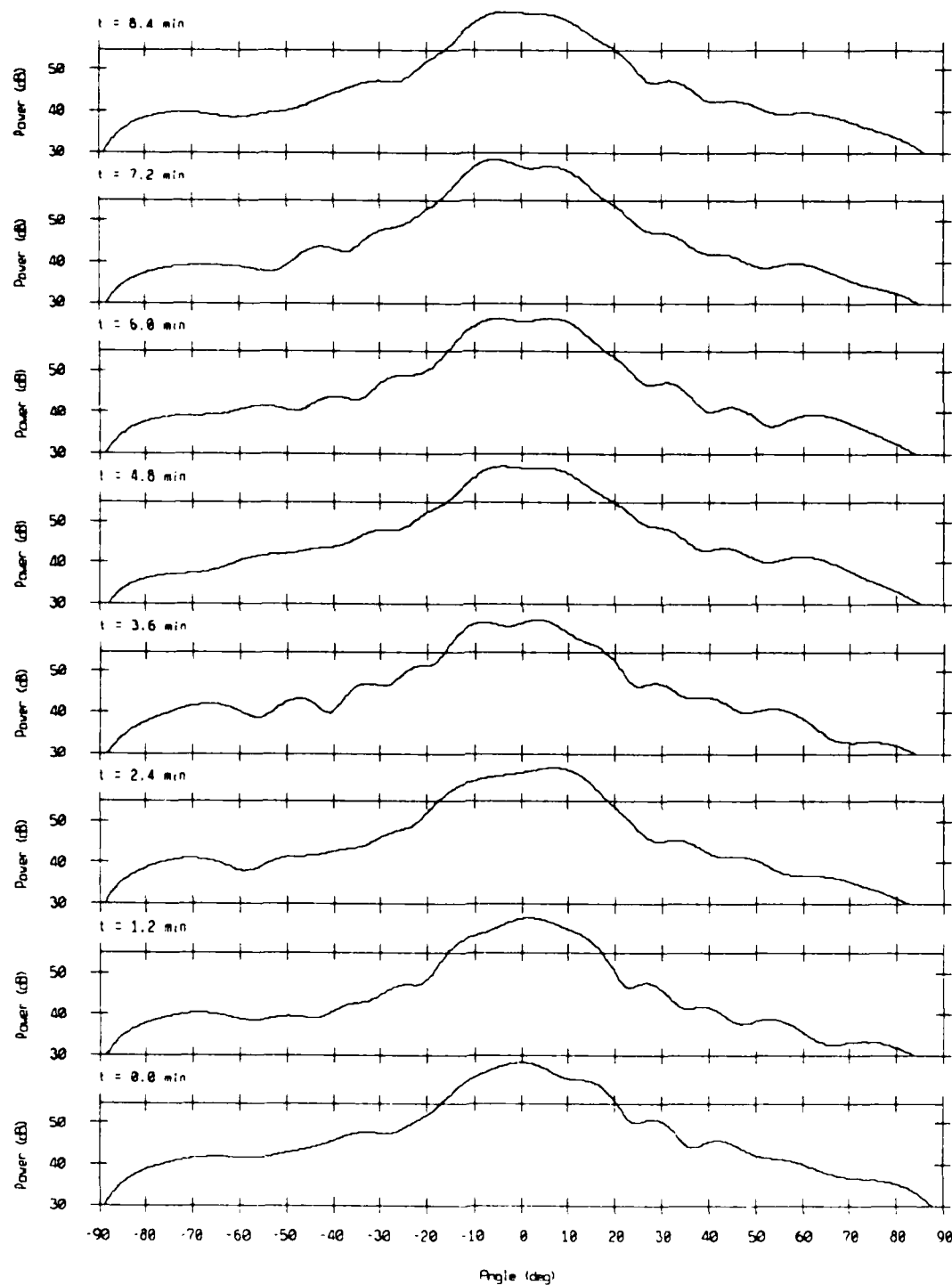
$f = 50$  Hz, rect window





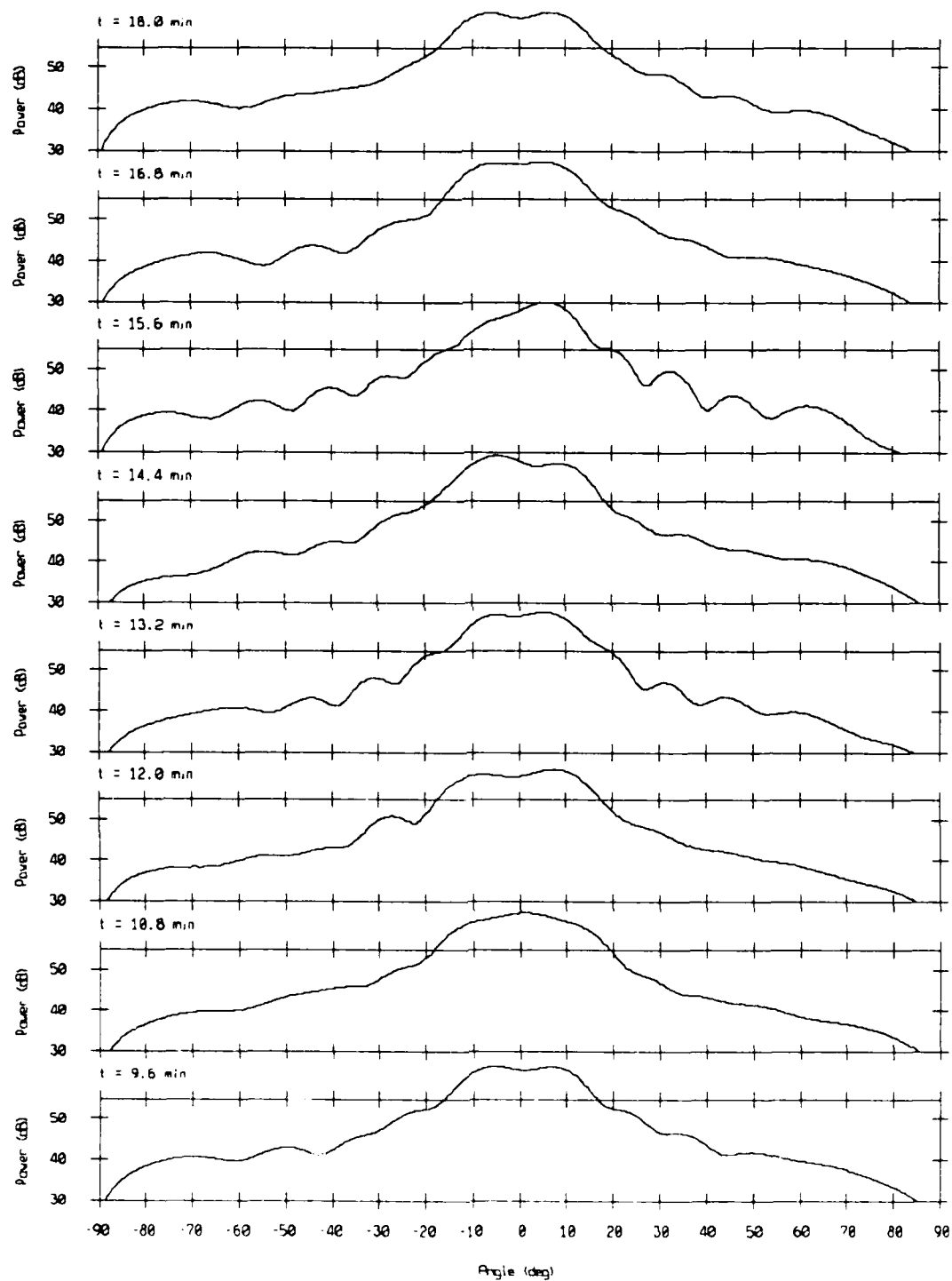
Array Response - 85010 Bin #4774

$f = 75$  Hz, rect window



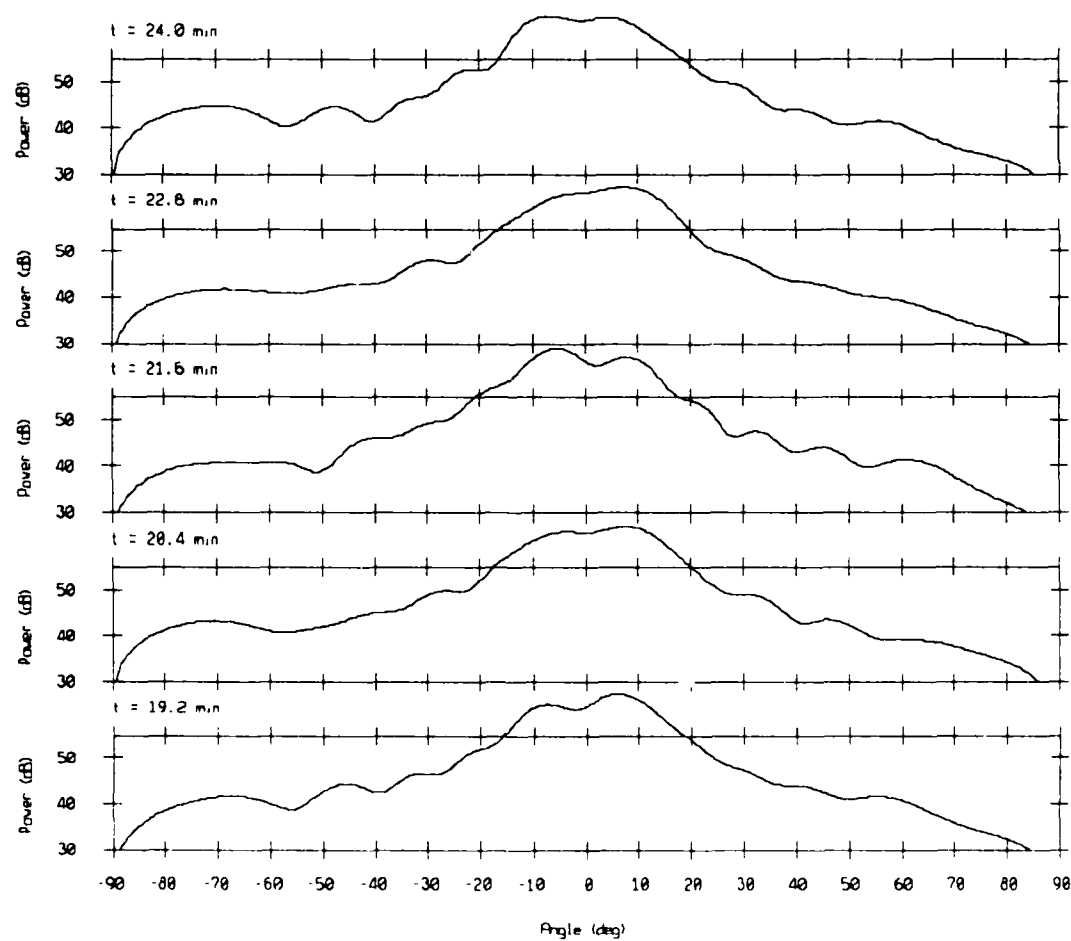
Array Response - 85010 Bin #4774

$f = 75$  Hz, rect window



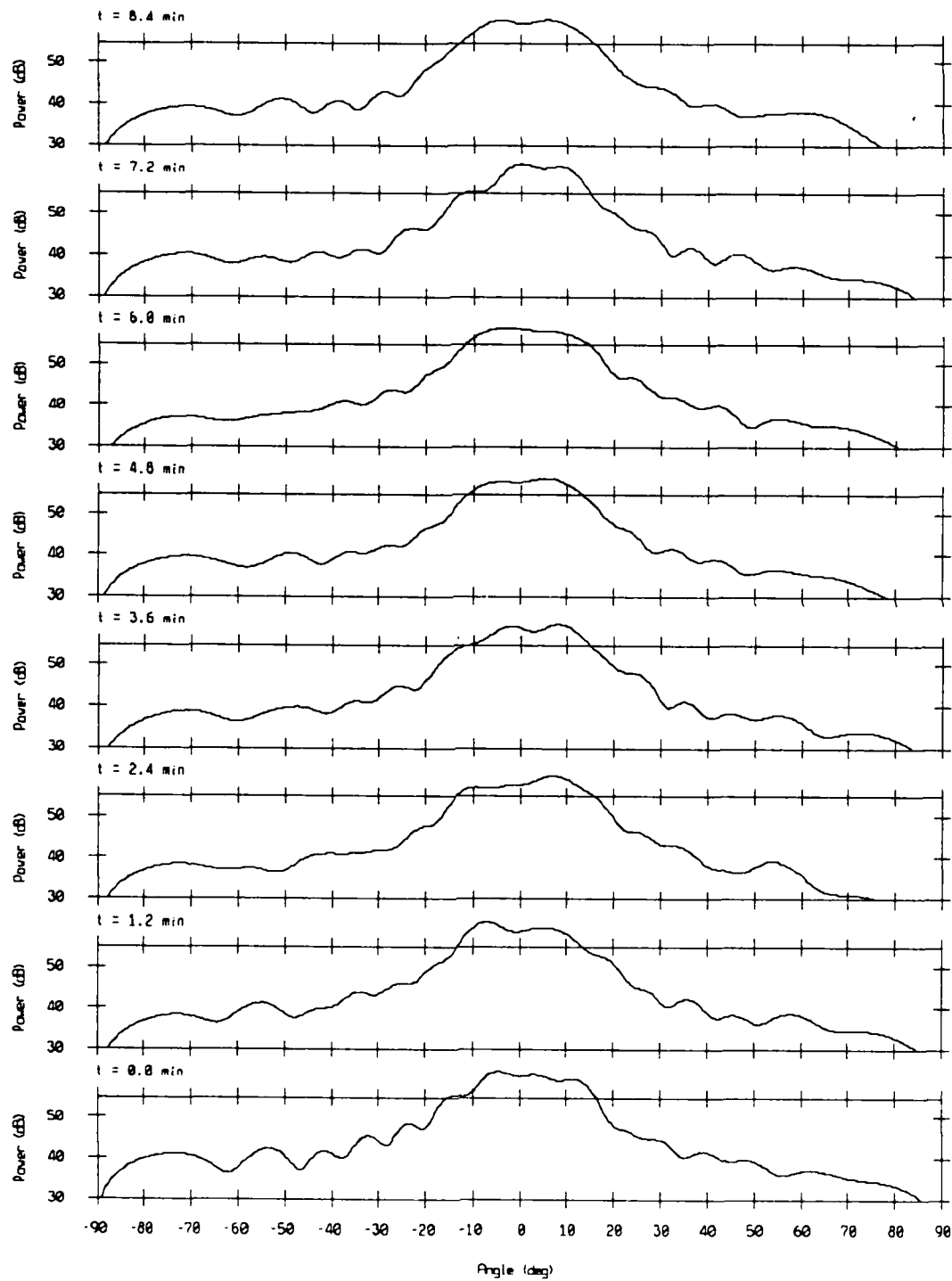
Array Response - 85010 Bin #4774

$f = 75$  Hz, rect window



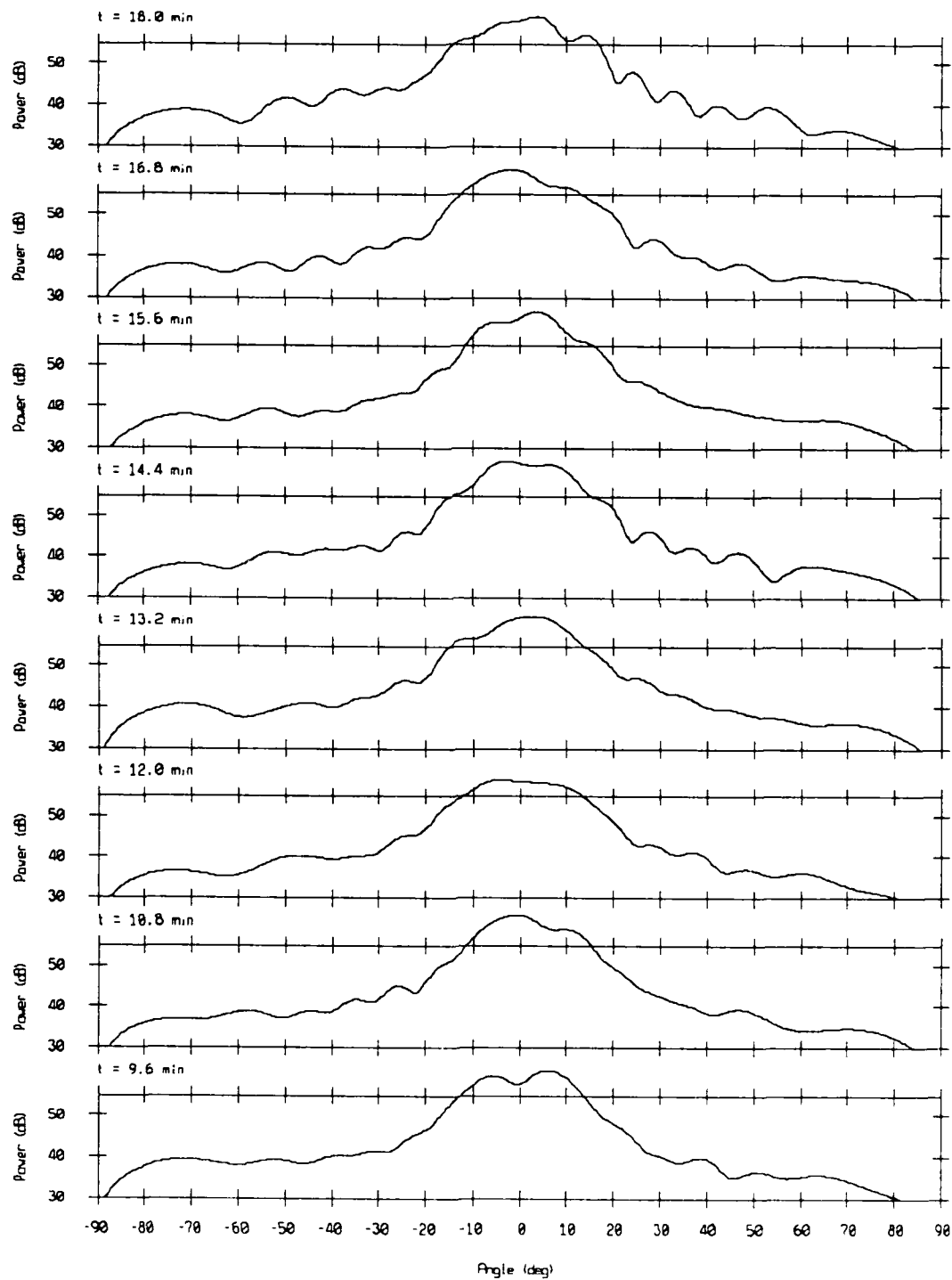
# Array Response - 85010 Bin #4999

$f = 100$  Hz, rect window



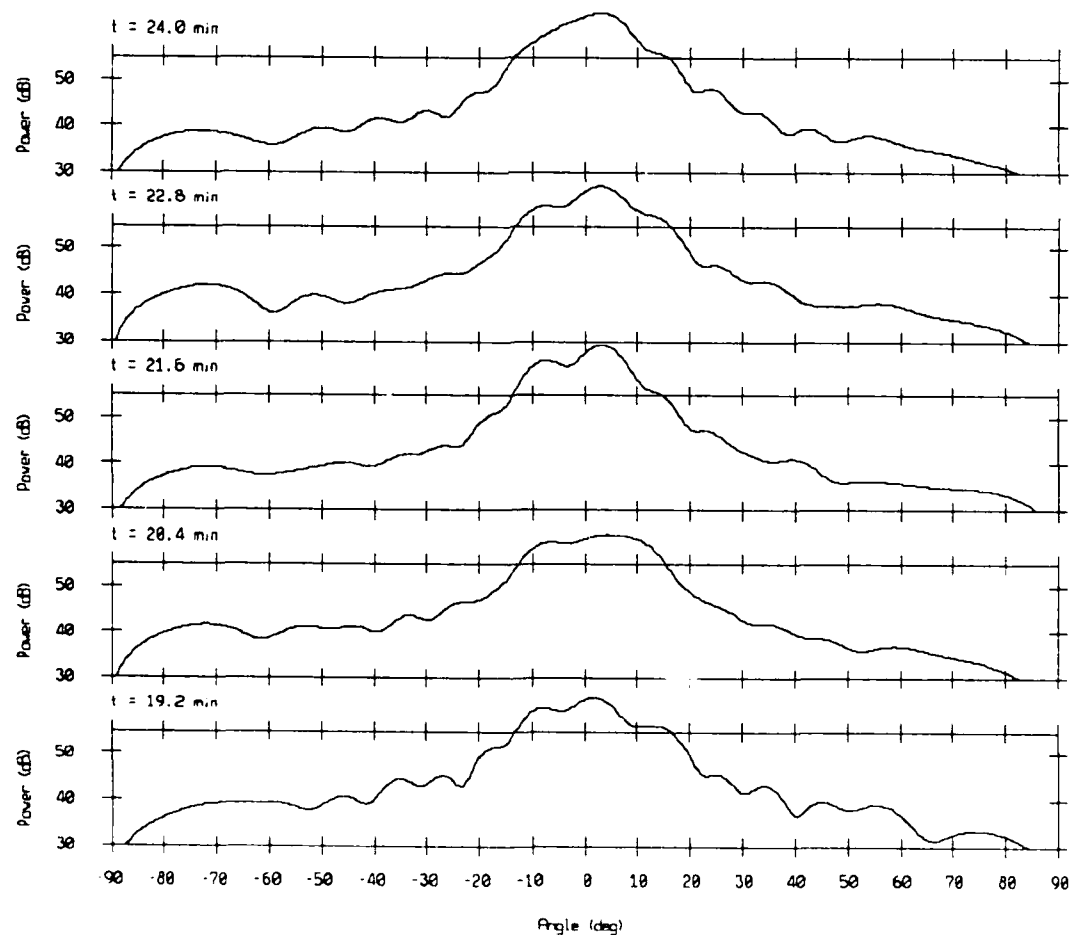
Array Response - 85010 Bin #4999

$f = 100$  Hz, rect window



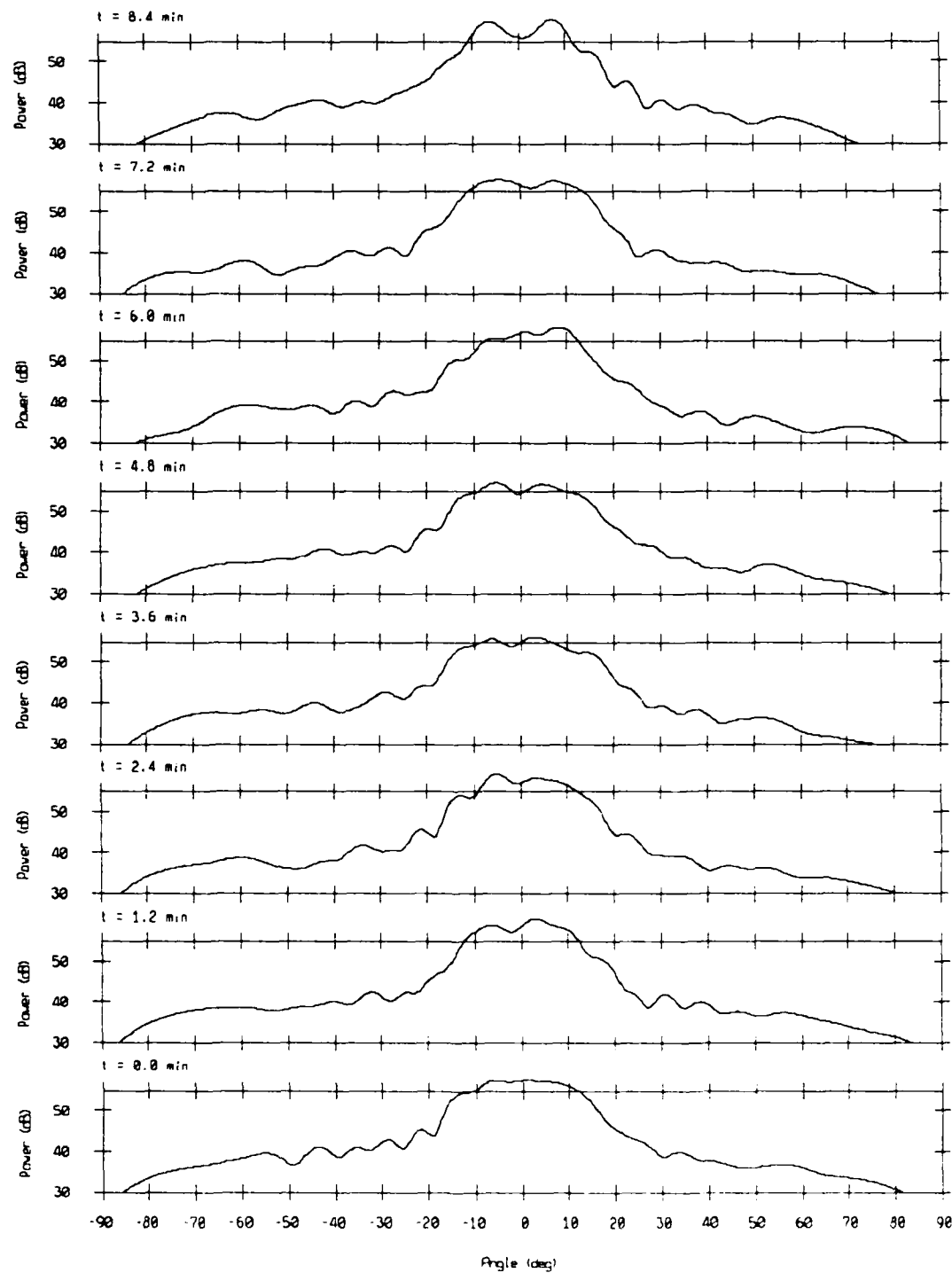
Array Response - 85010 Bin #4999

$f = 100$  Hz, rect window



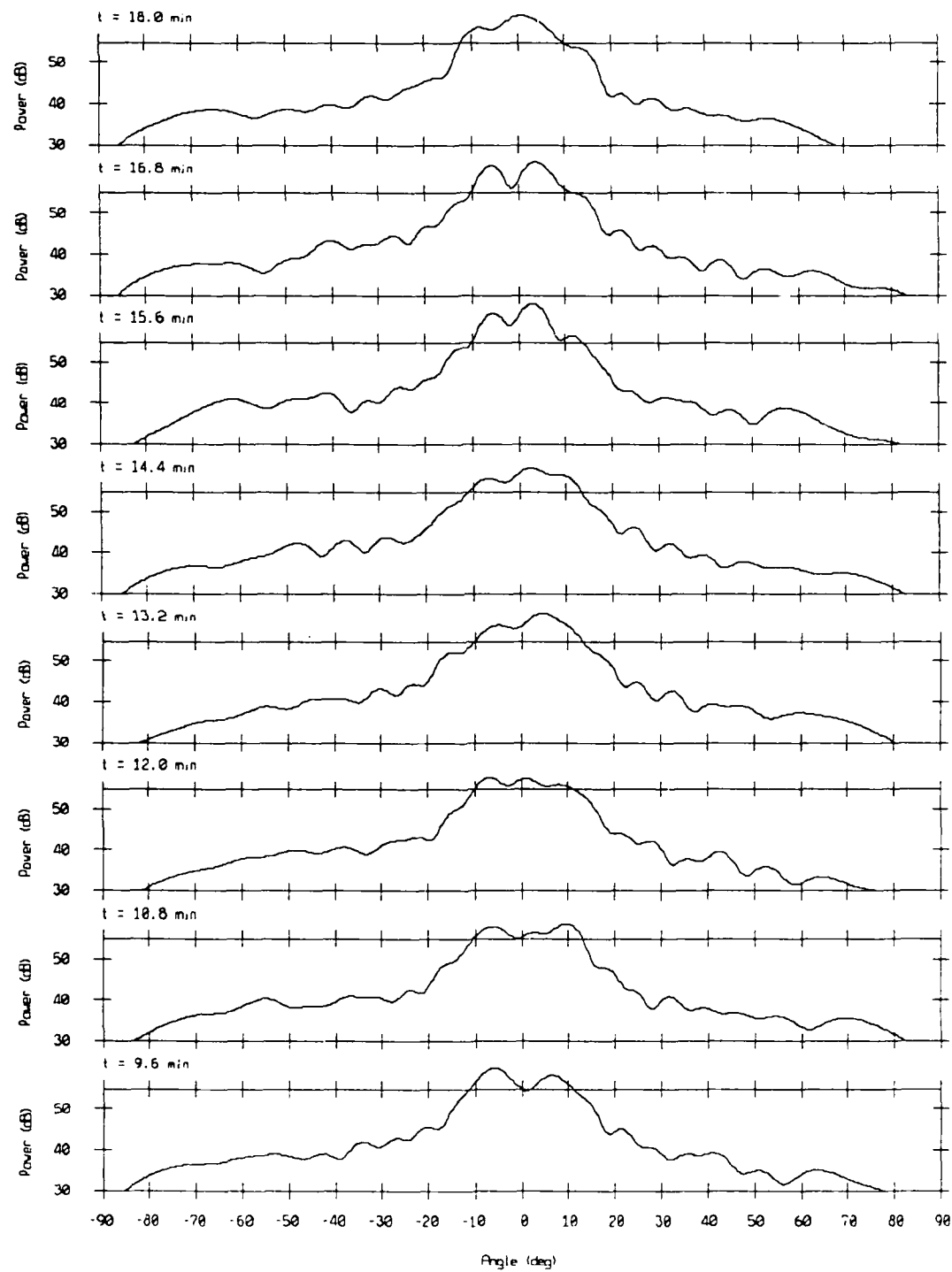
# Array Response - 85010 Bin #5225

$f = 125$  Hz, rect window



# Array Response - 85010 Bin #5225

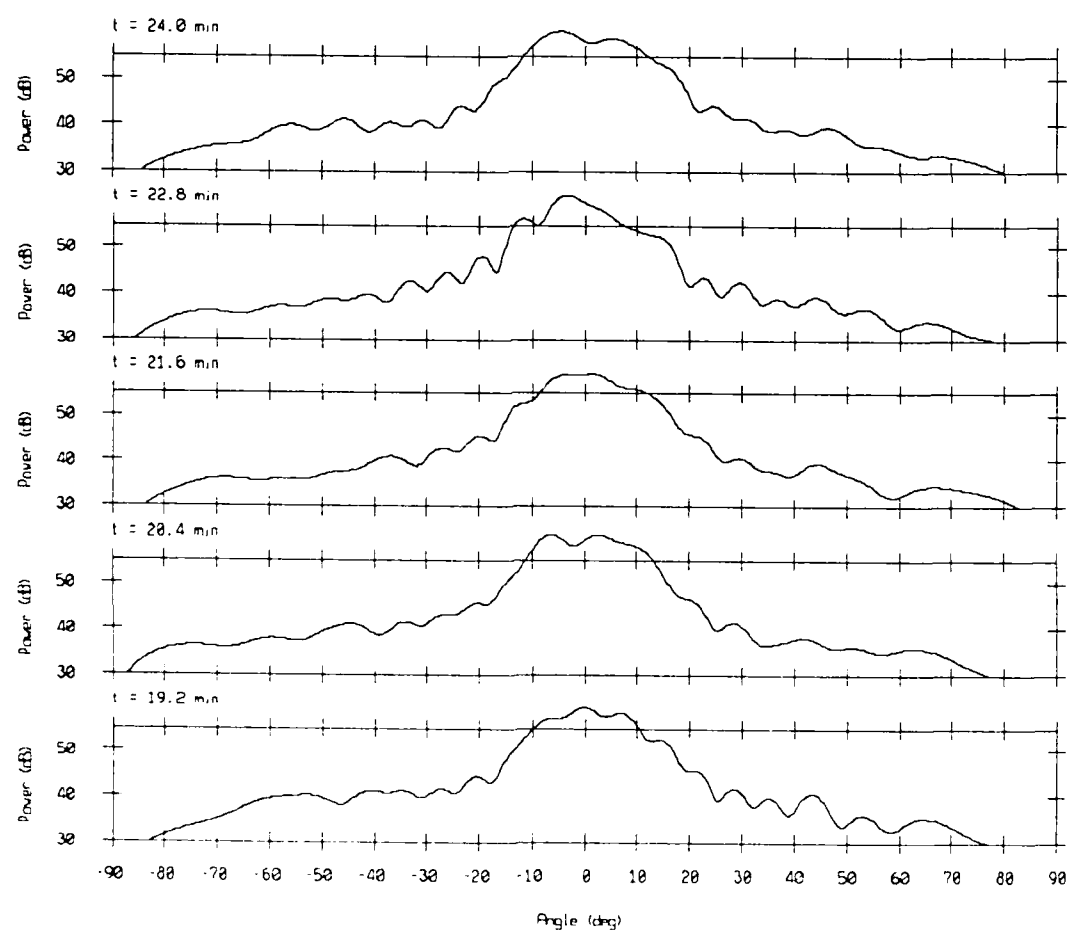
$f = 125$  Hz, rect window





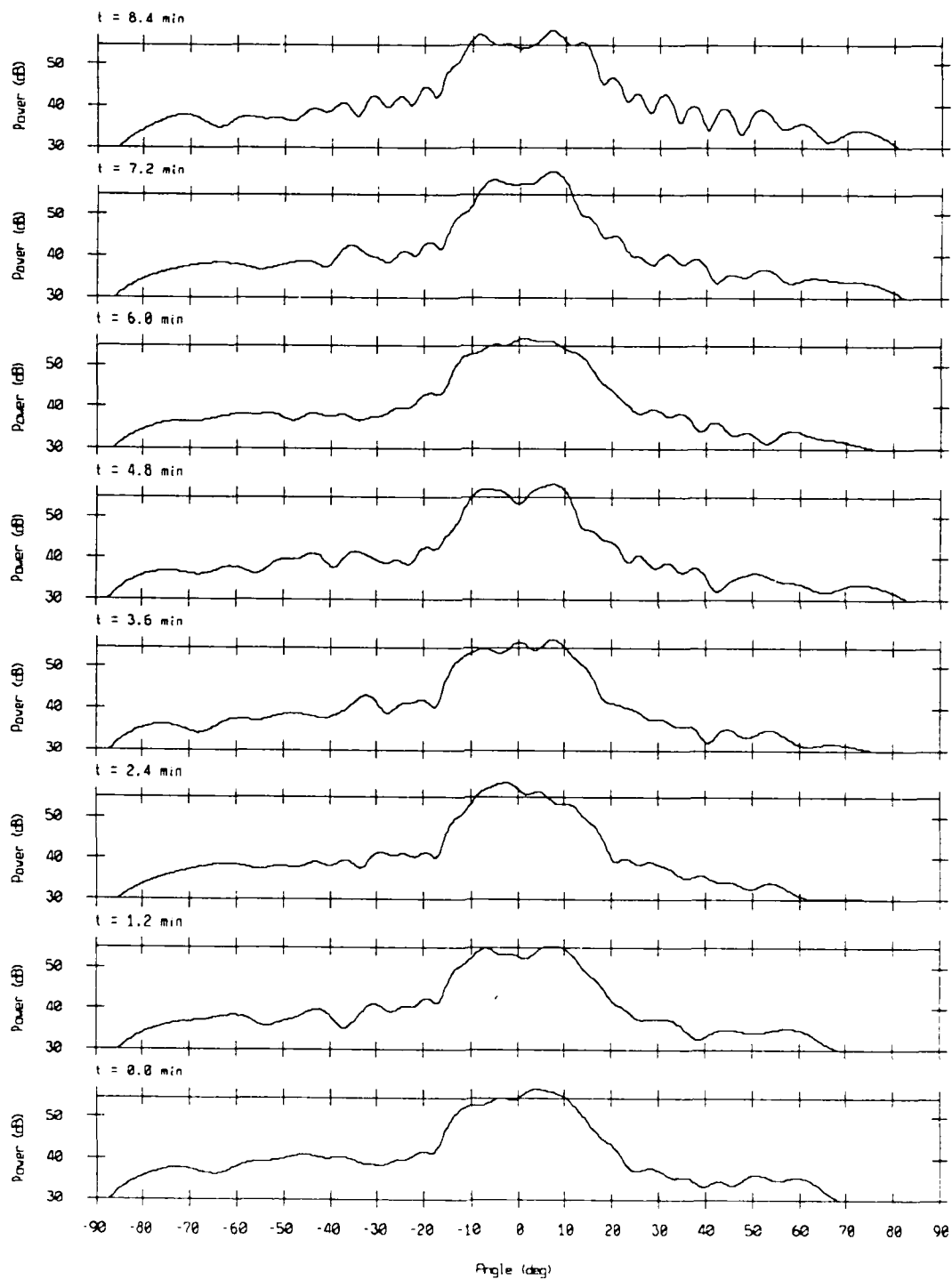
Array Response - 85010 Bin #5225

$f = 125$  Hz, rect window



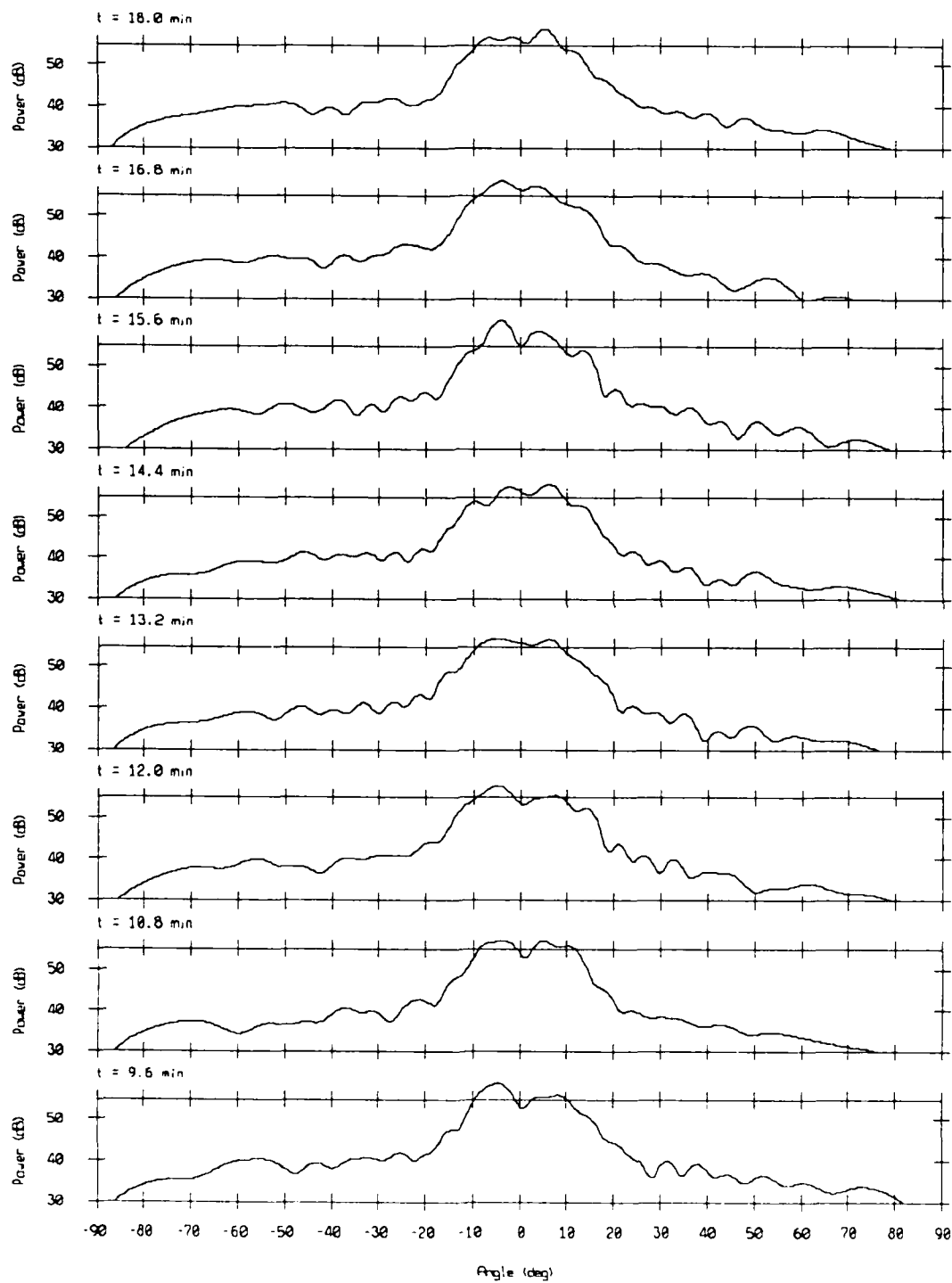
# Array Response - 85010 Bin #5451

$f = 150$  Hz, rect window



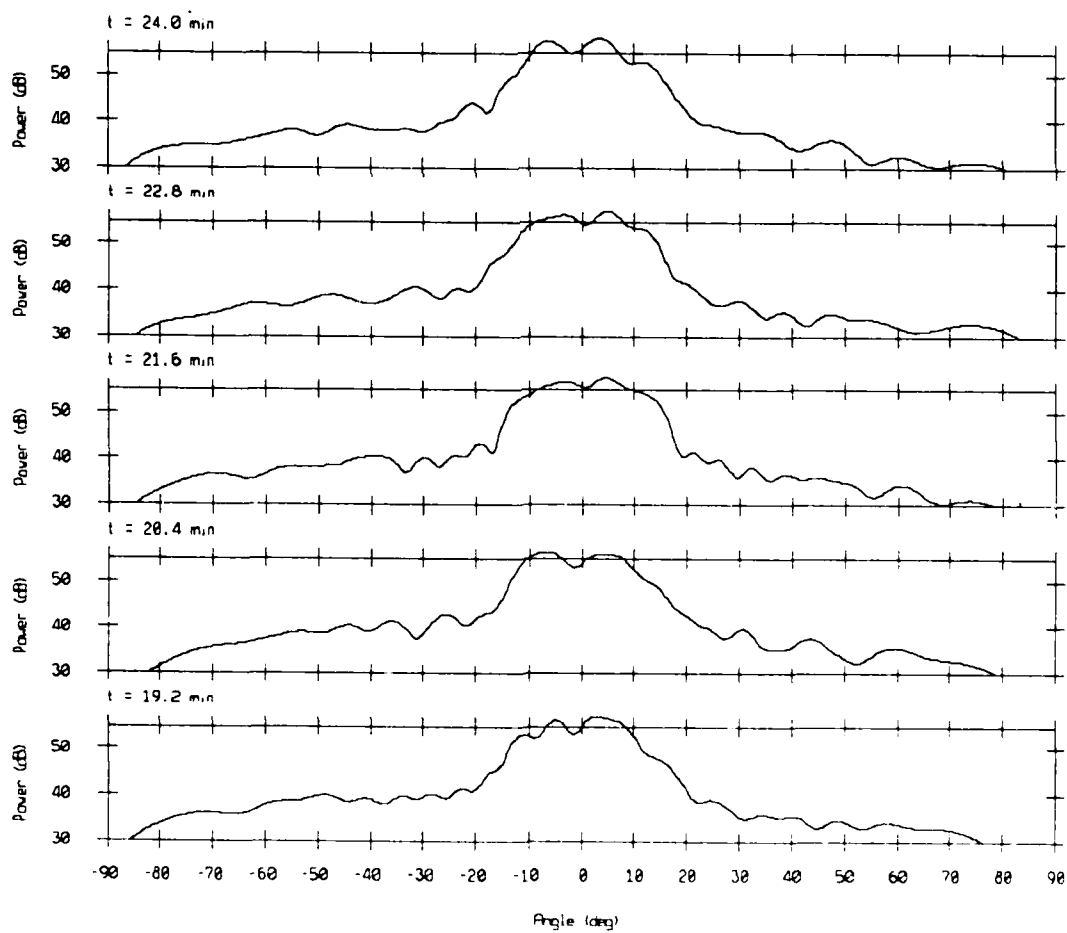
Array Response - 85010 Bin #5451

$f = 150$  Hz, rect window



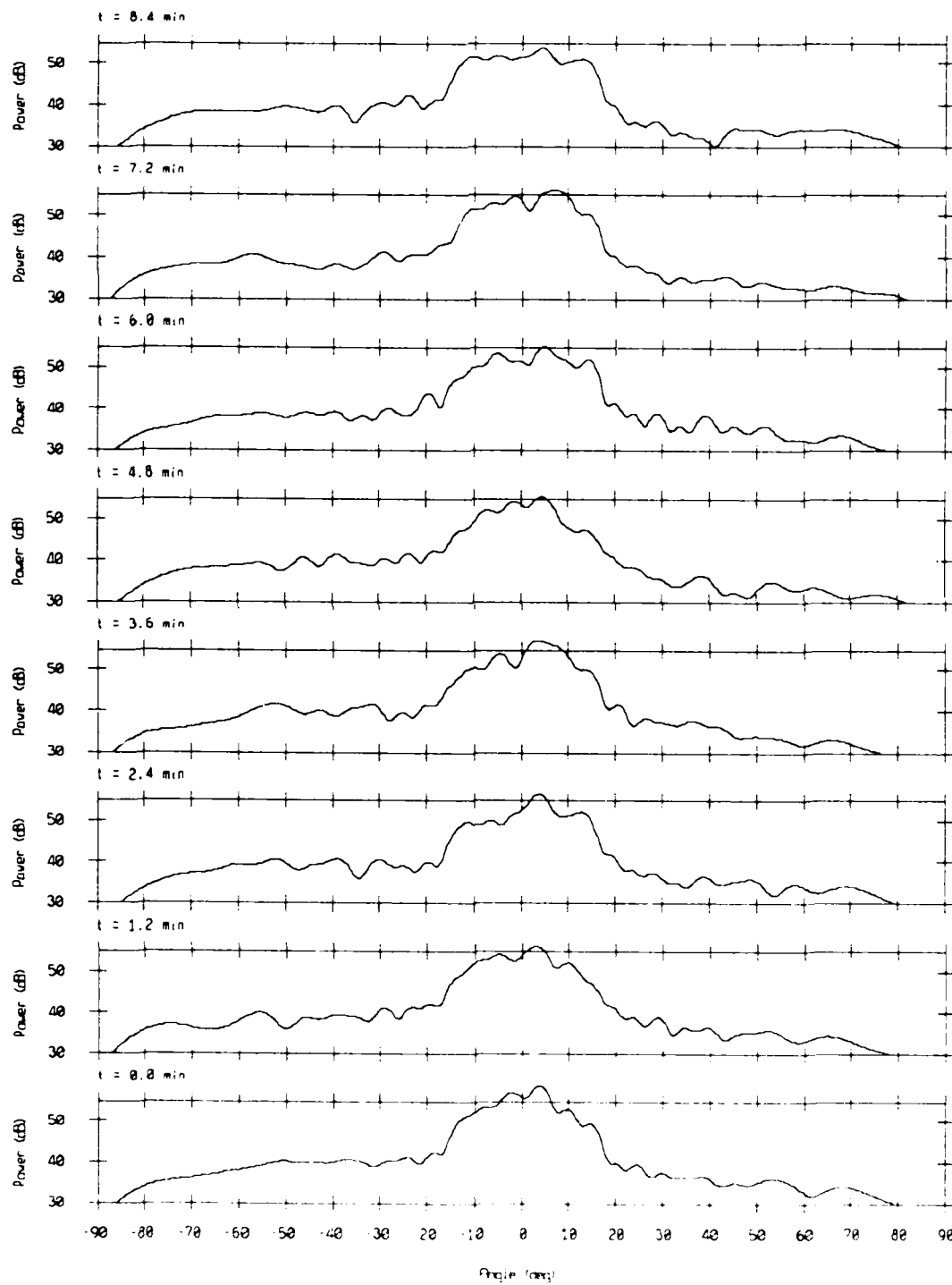
Array Response - 85010 Bin #5451

$f = 150$  Hz, rect window



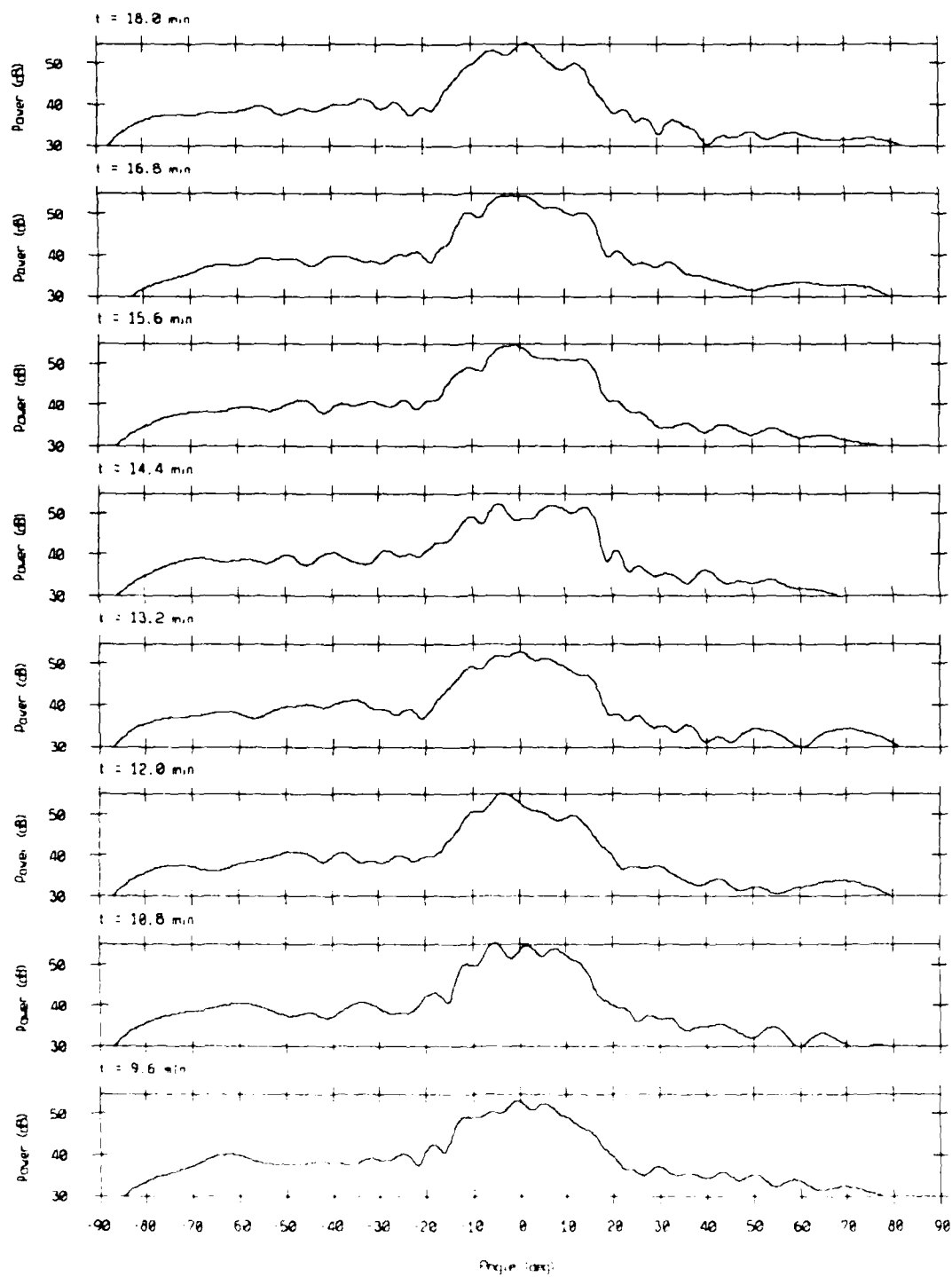
Array Response - 85010 Bin #5676

$f = 175$  Hz, rect window



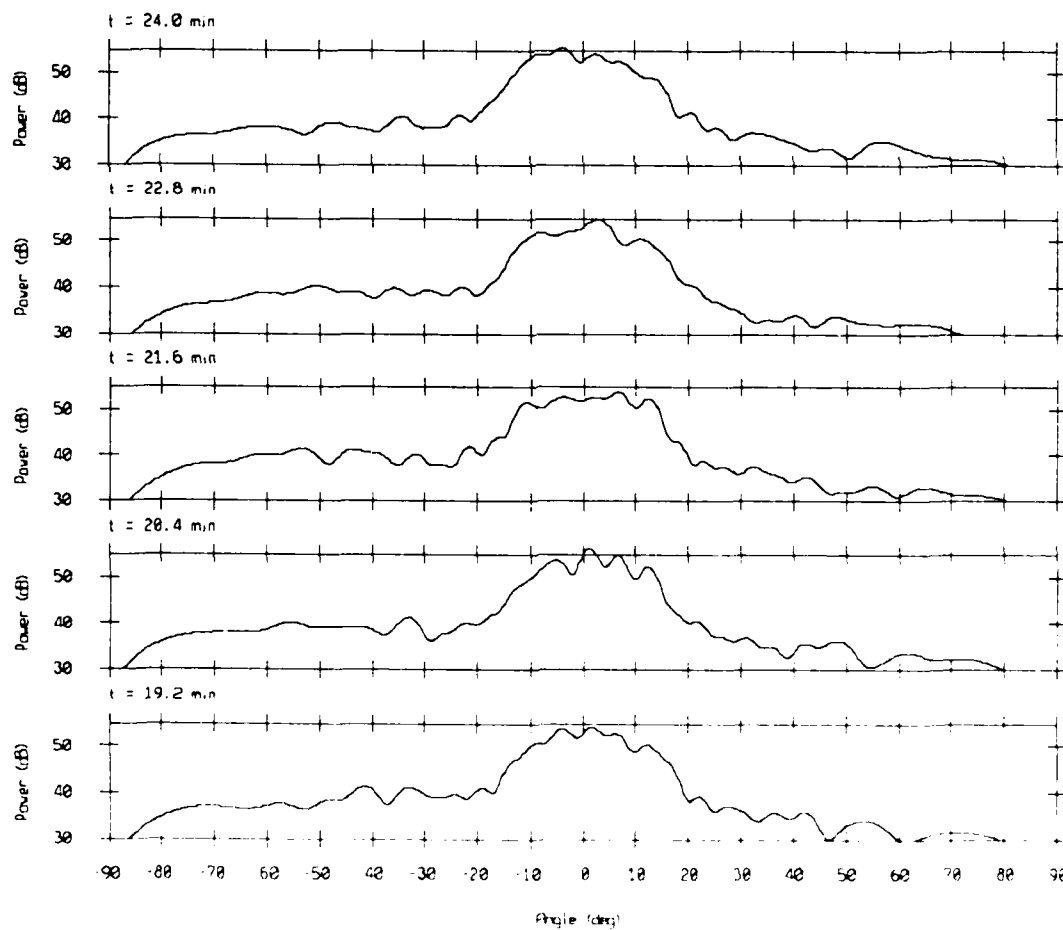
Array Response - 85010 Bin #5676

$f = 175$  Hz, rect window



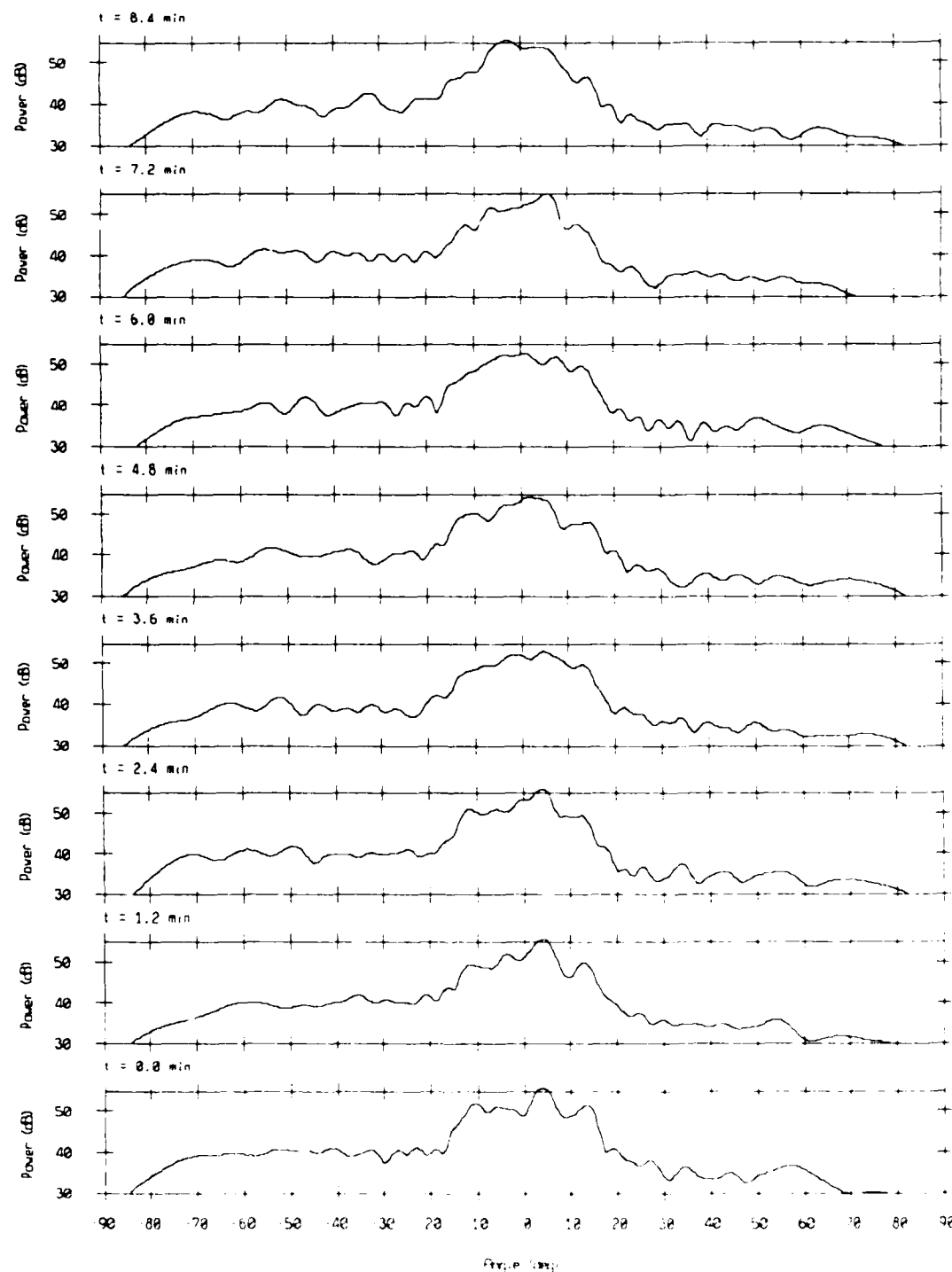
Array Response - 85010 Bin #5676

$f = 175$  Hz, rect window



Array Response - 85010 Bin #5902

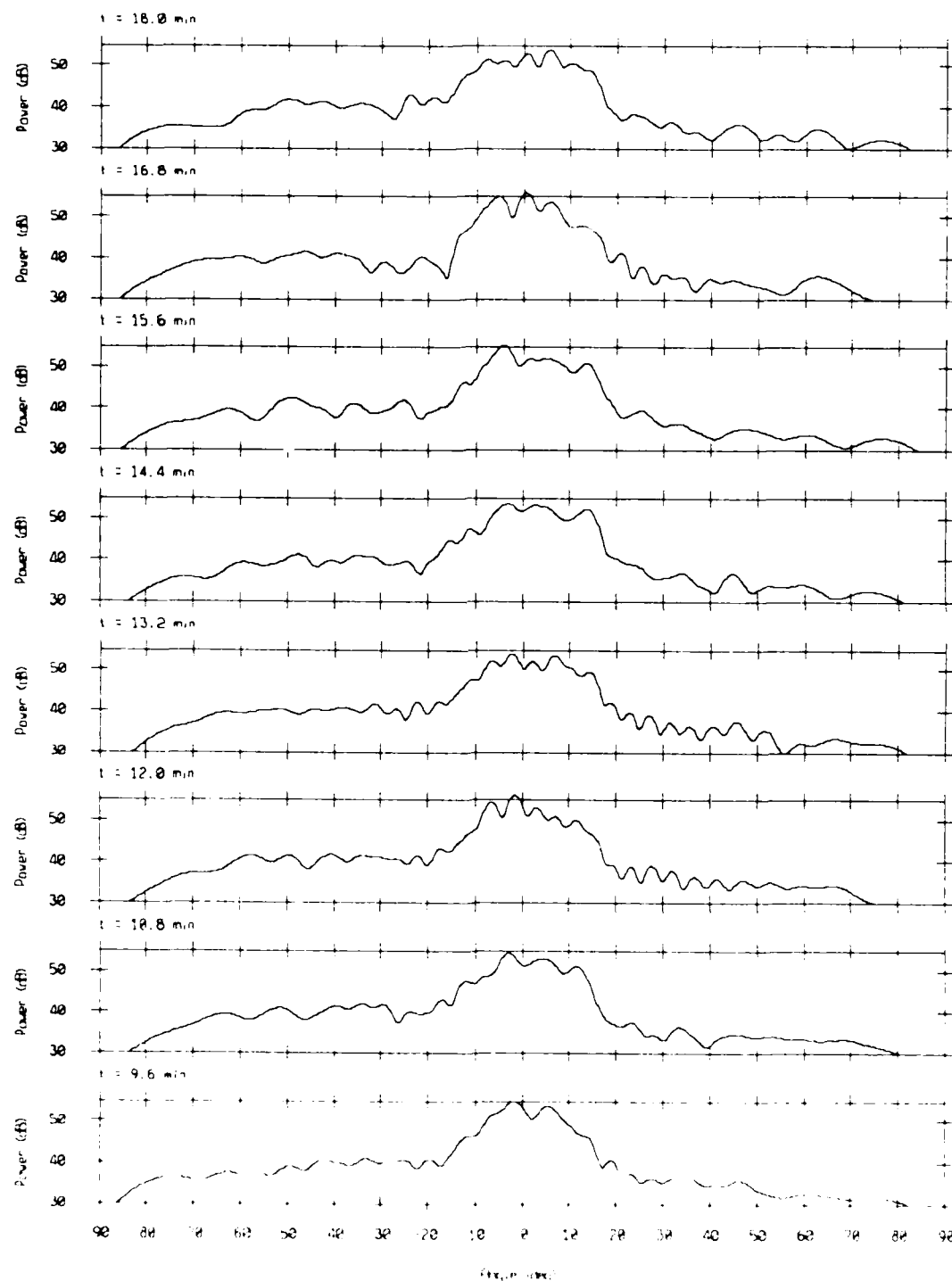
$f = 200$  Hz, rect window





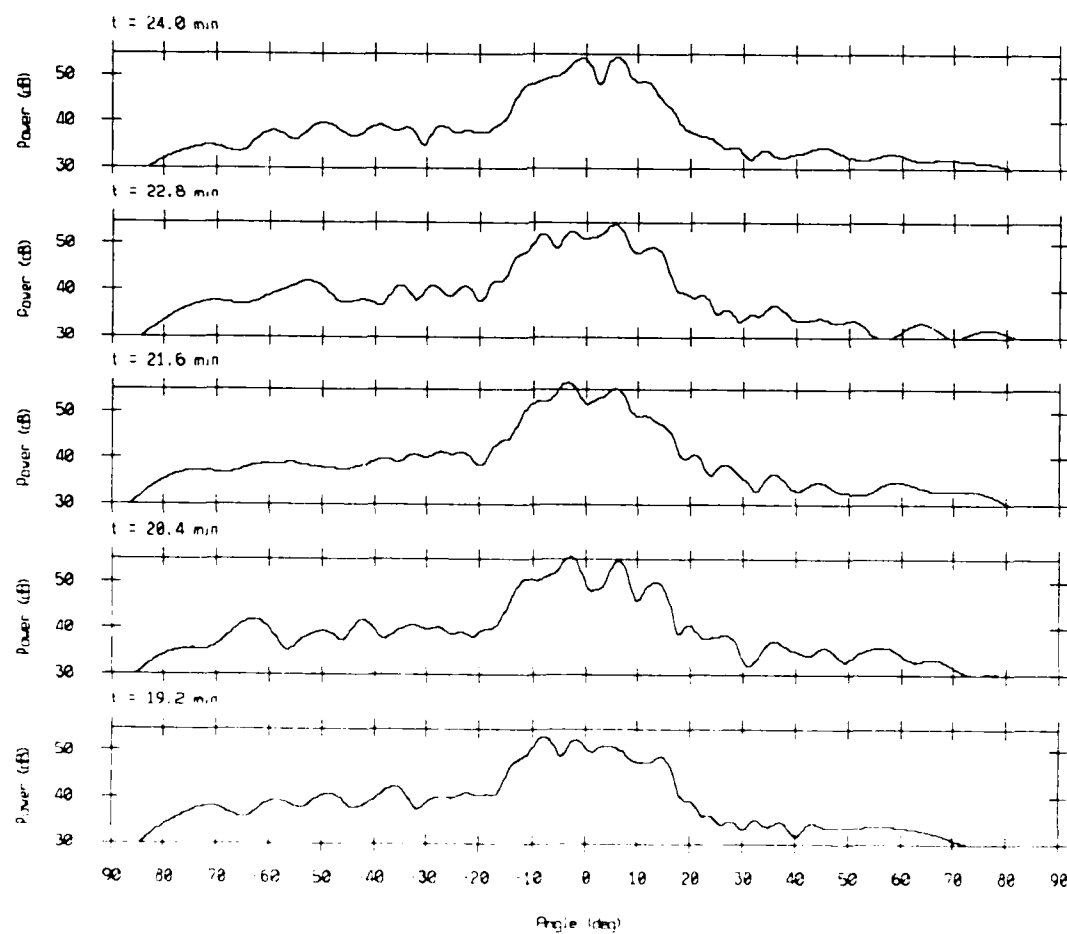
Array Response - 85010 Bin #5902

$f = 200$  Hz, rect window



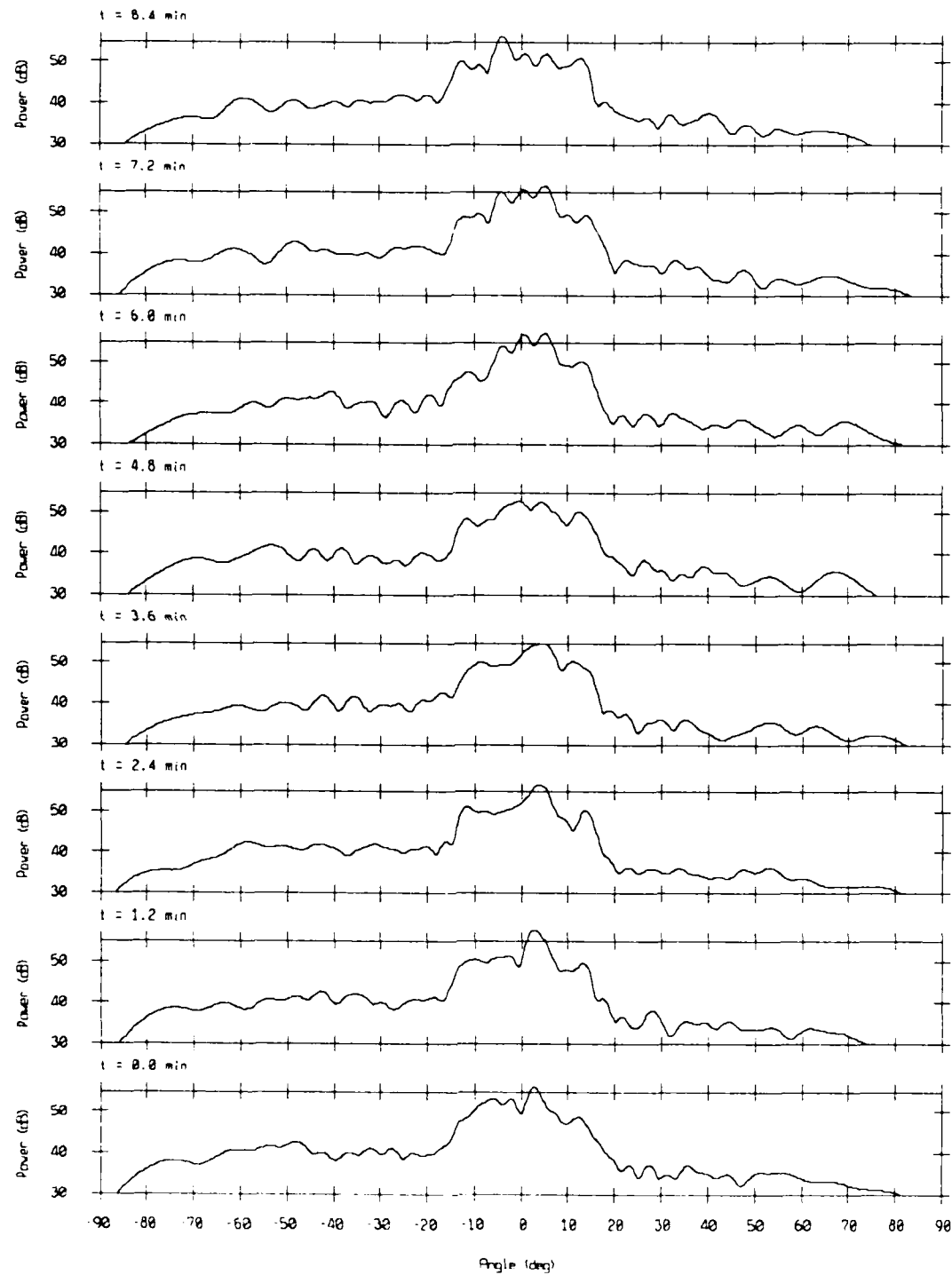
Array Response - 85010 Bin #5902

$f = 200$  Hz, rect window

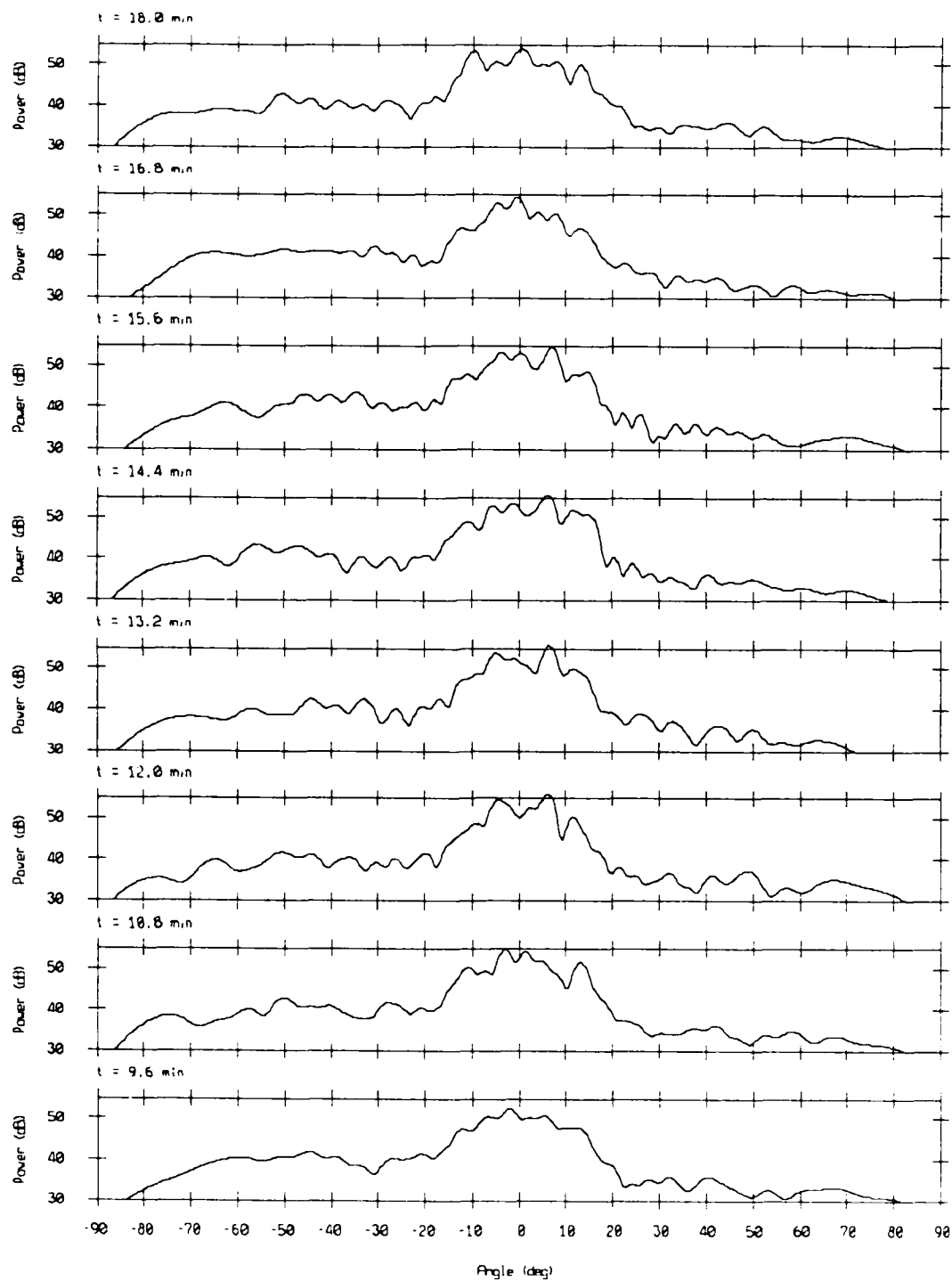


Array Response - 85010 Bin #6127

$f = 225$  Hz, rect window

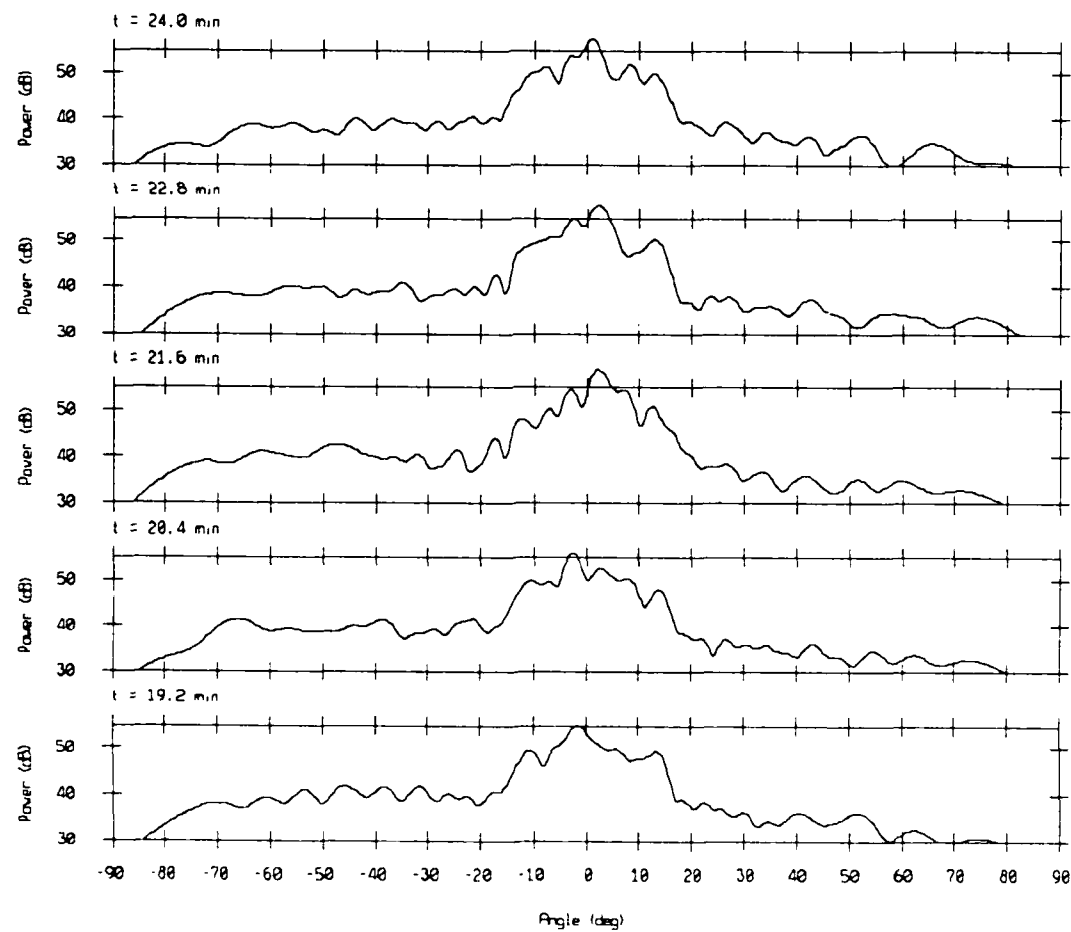


$f = 225$  Hz, rect window



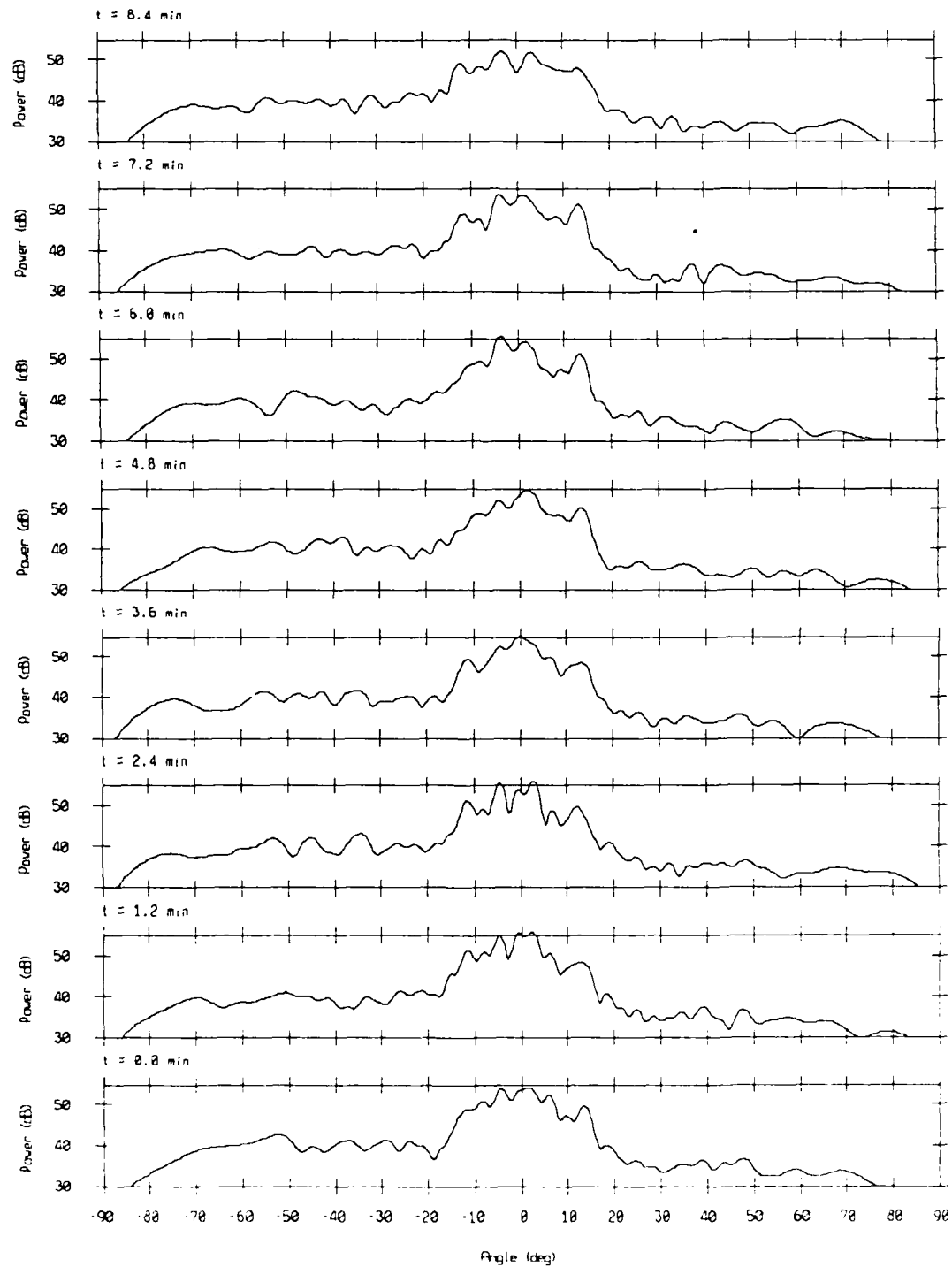
Array Response - 85010 Bin #6127

$f = 225$  Hz, rect window



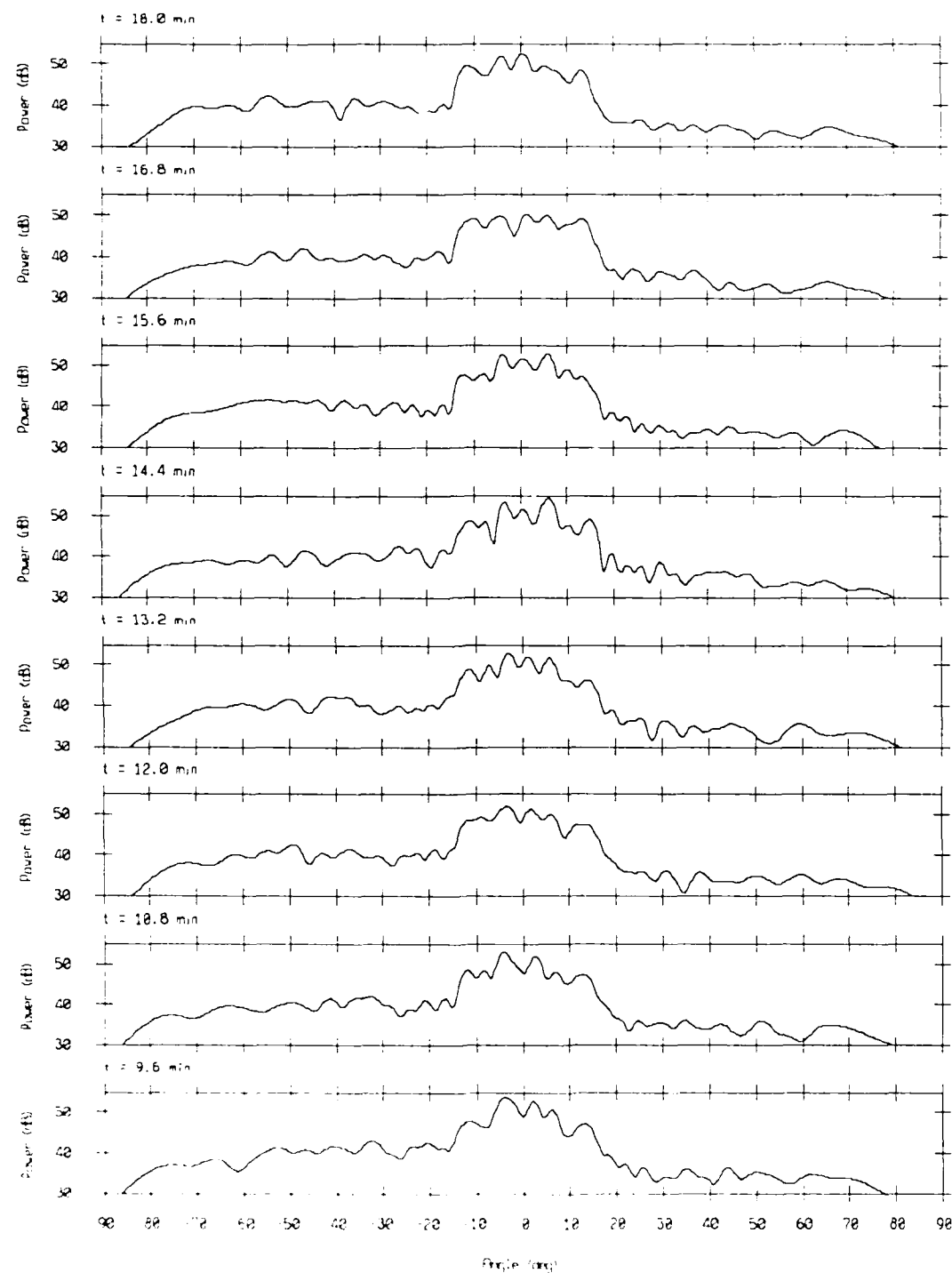
Array Response - 85010 Bin #6354

$f = 250$  Hz, rect window



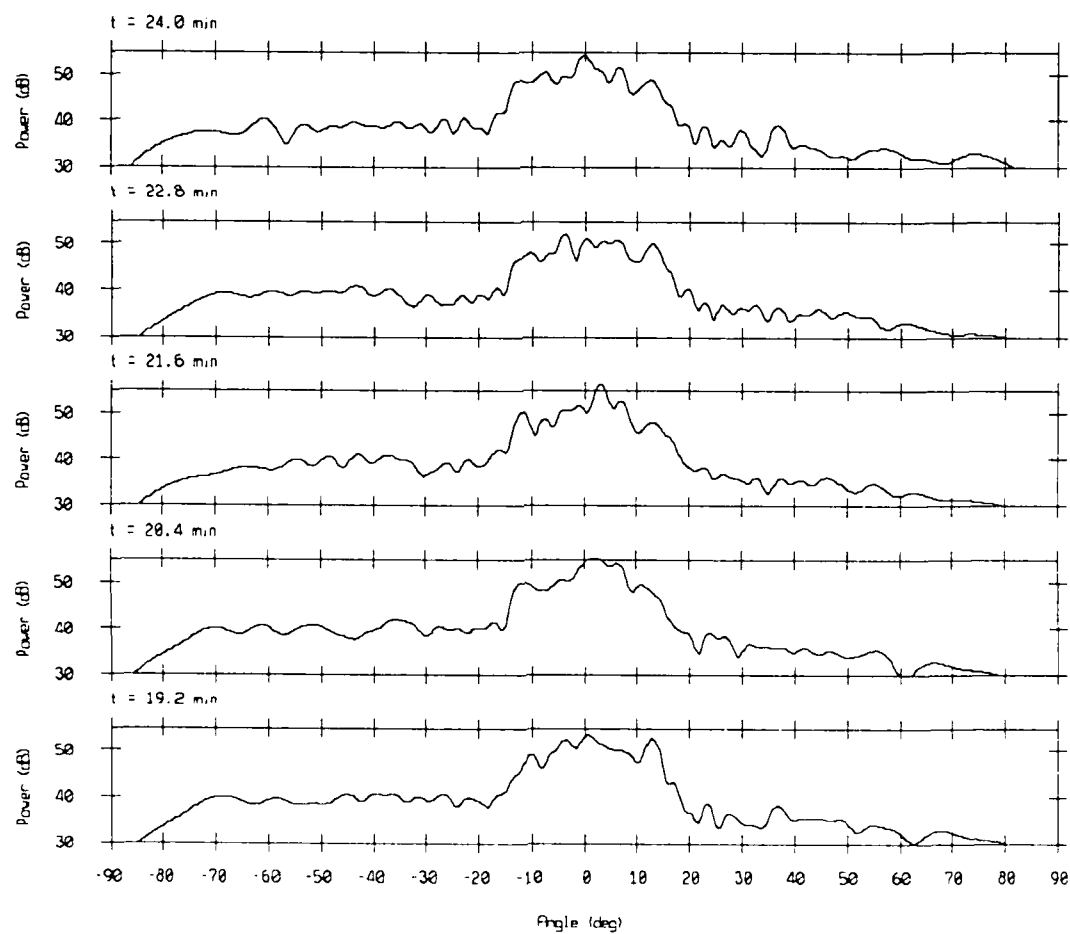
Array Response - 85010 Bin #6354

$f = 250$  Hz, rect window



Array Response - 85010 Bin #6354

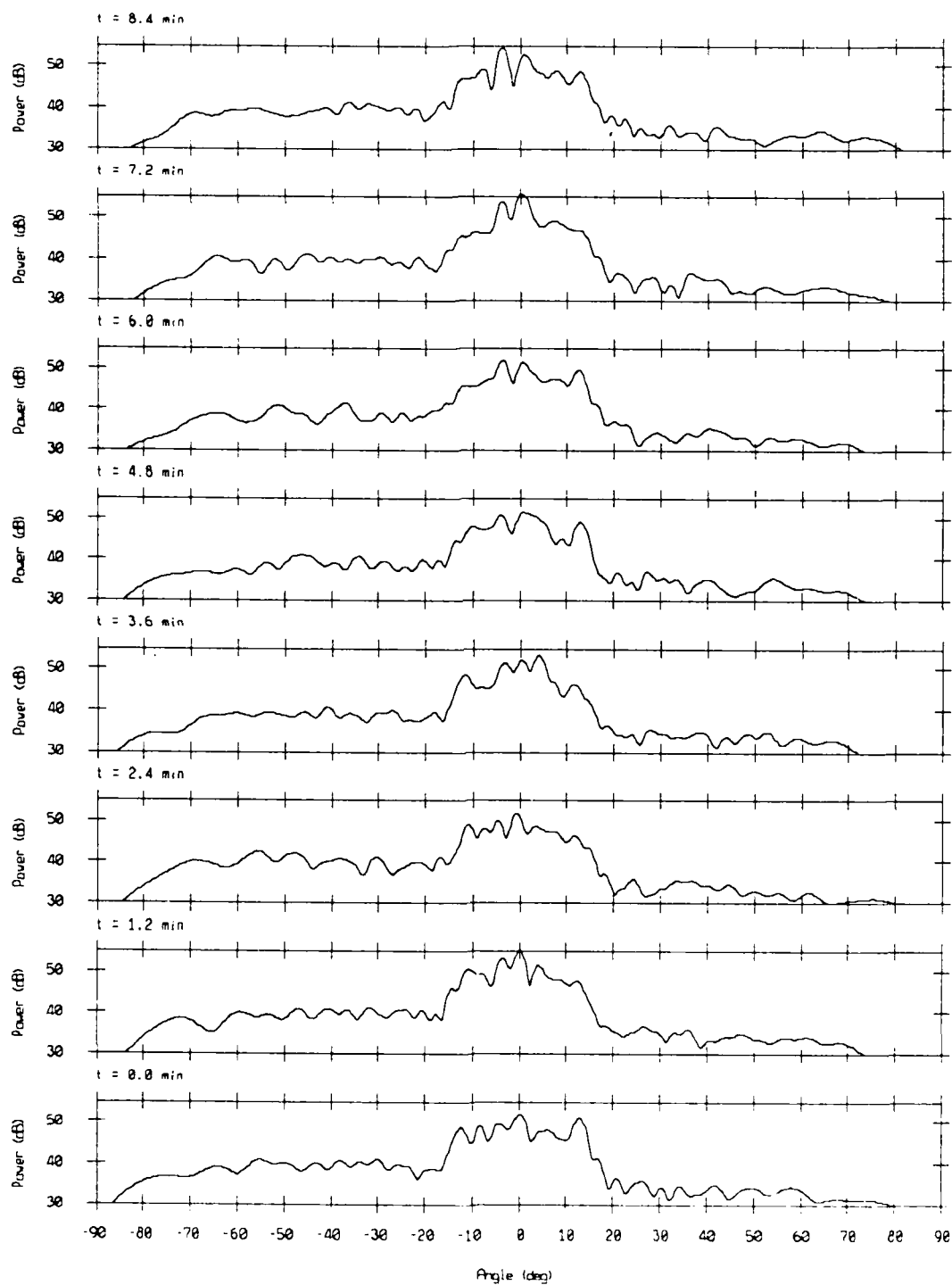
$f = 250$  Hz, rect window





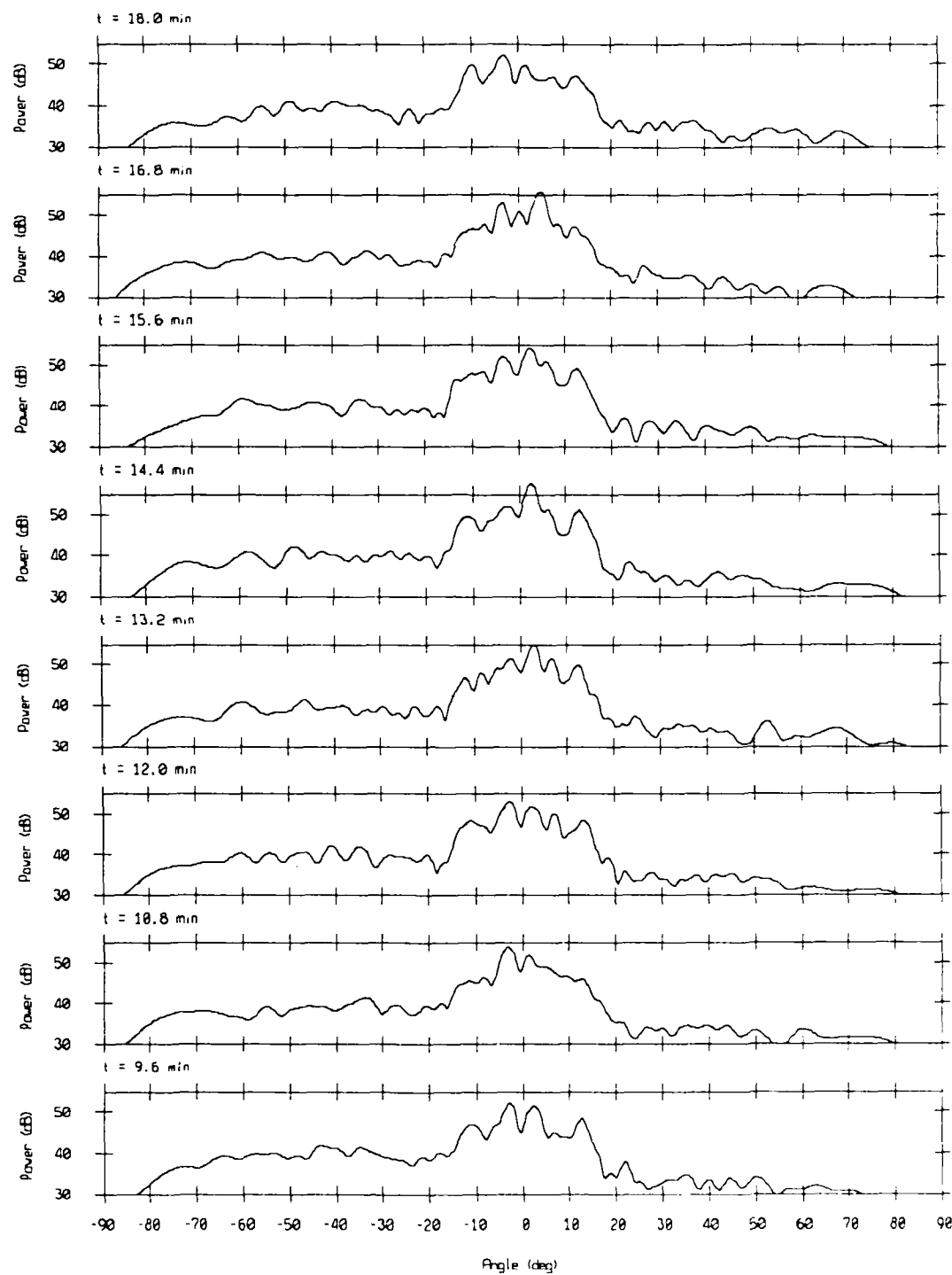
Array Response - 85010 Bin #6579

$f = 275$  Hz, rect window



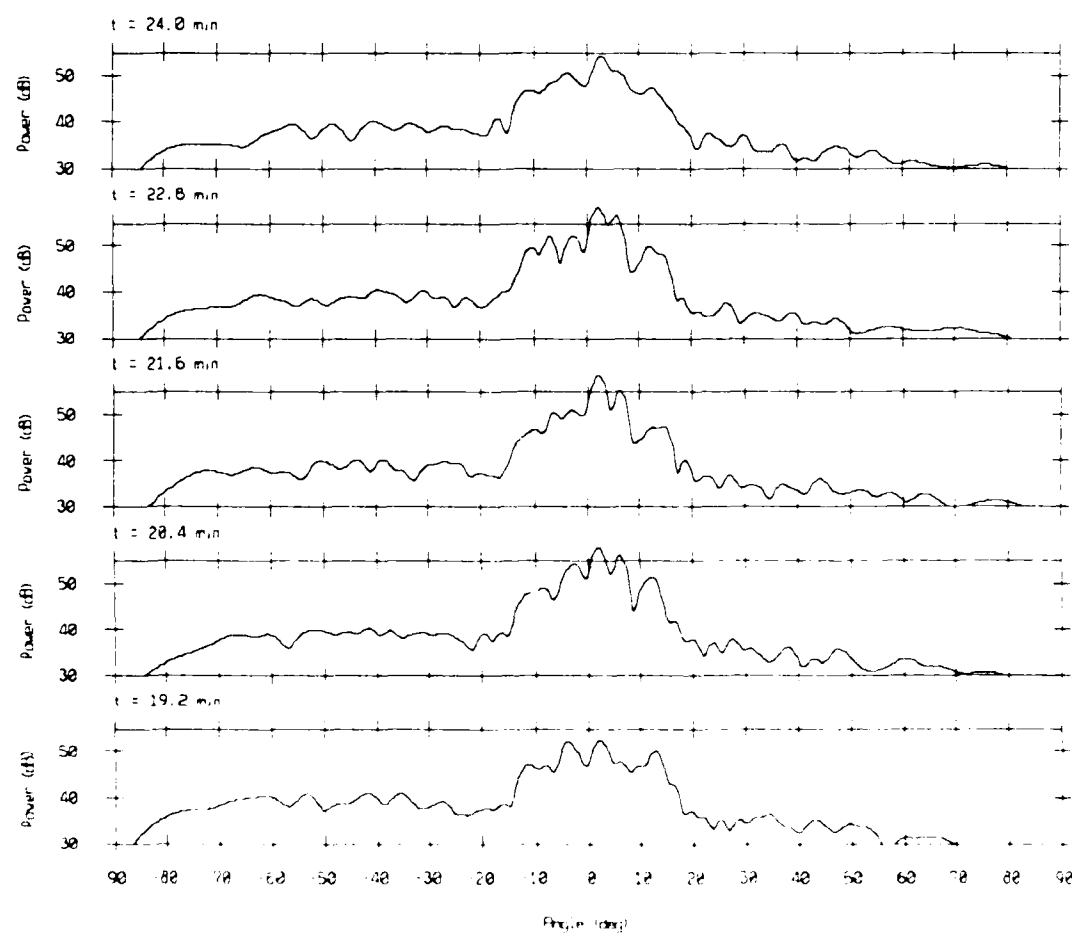
Array Response - 85010 Bin #6579

$f = 275$  Hz, rect window



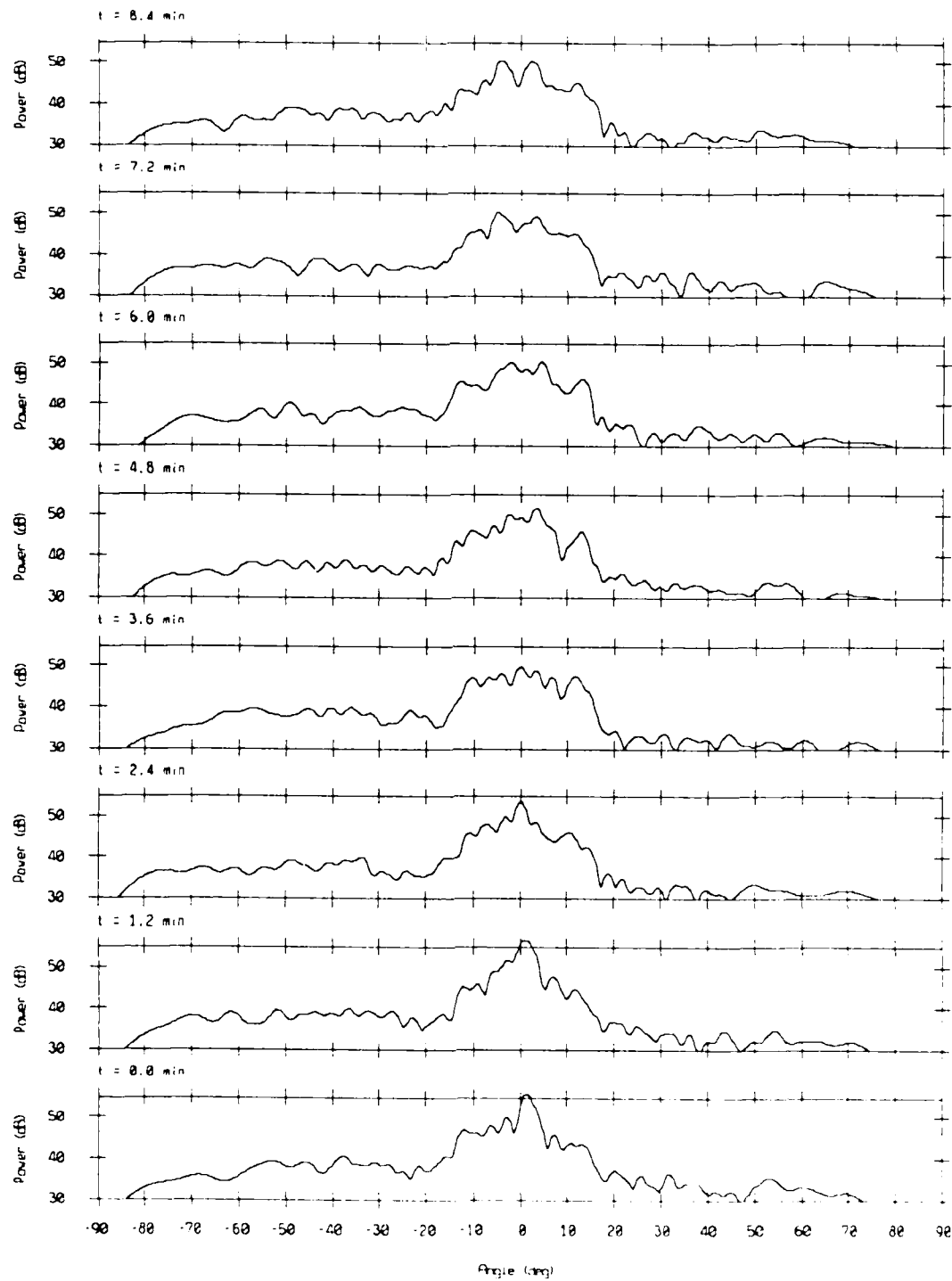
Array Response - 85010 Bin #6579

$f = 275$  Hz rect window



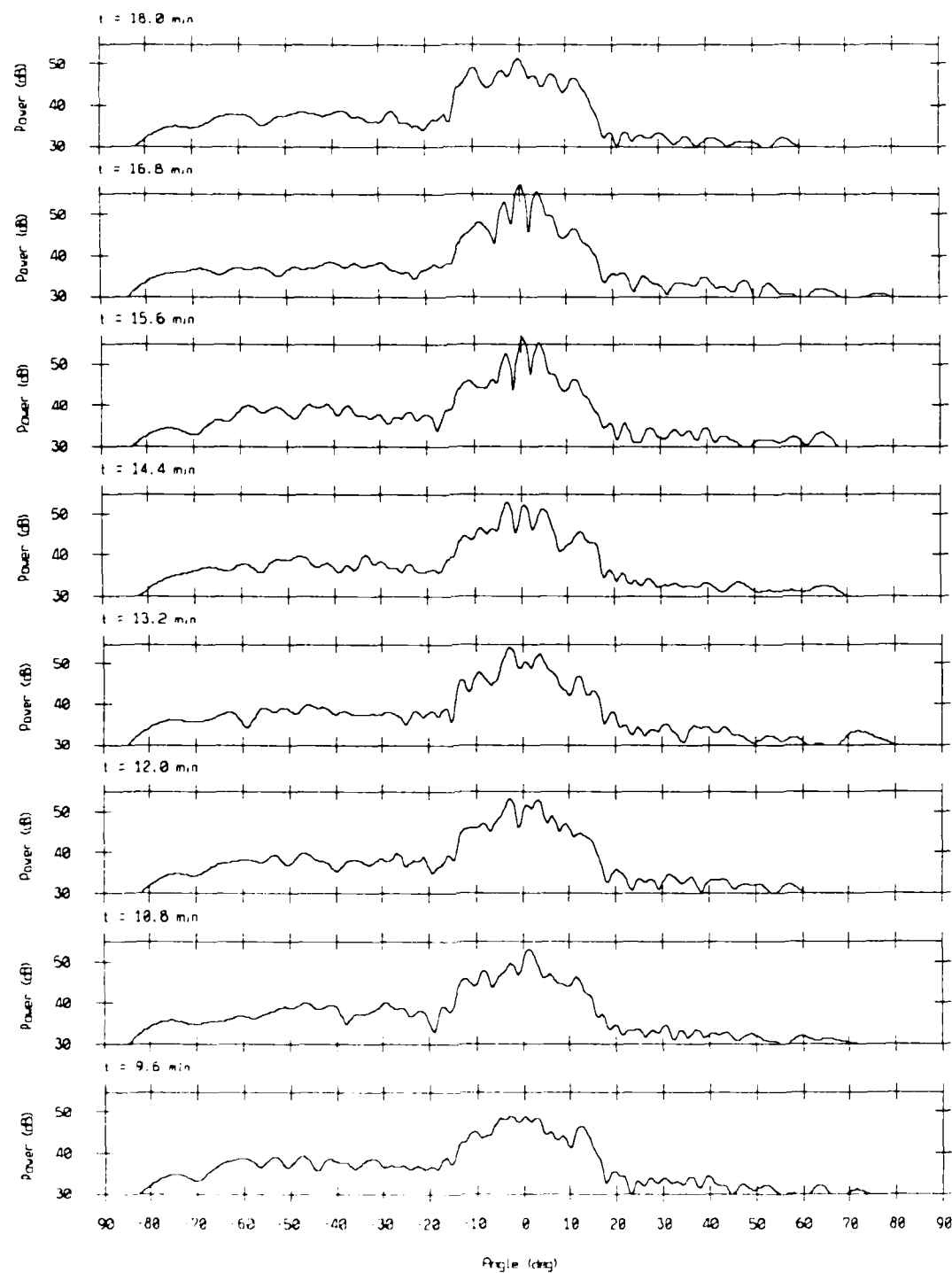
Array Response - 85010 Bin #6804

$f = 302$  Hz, rect window



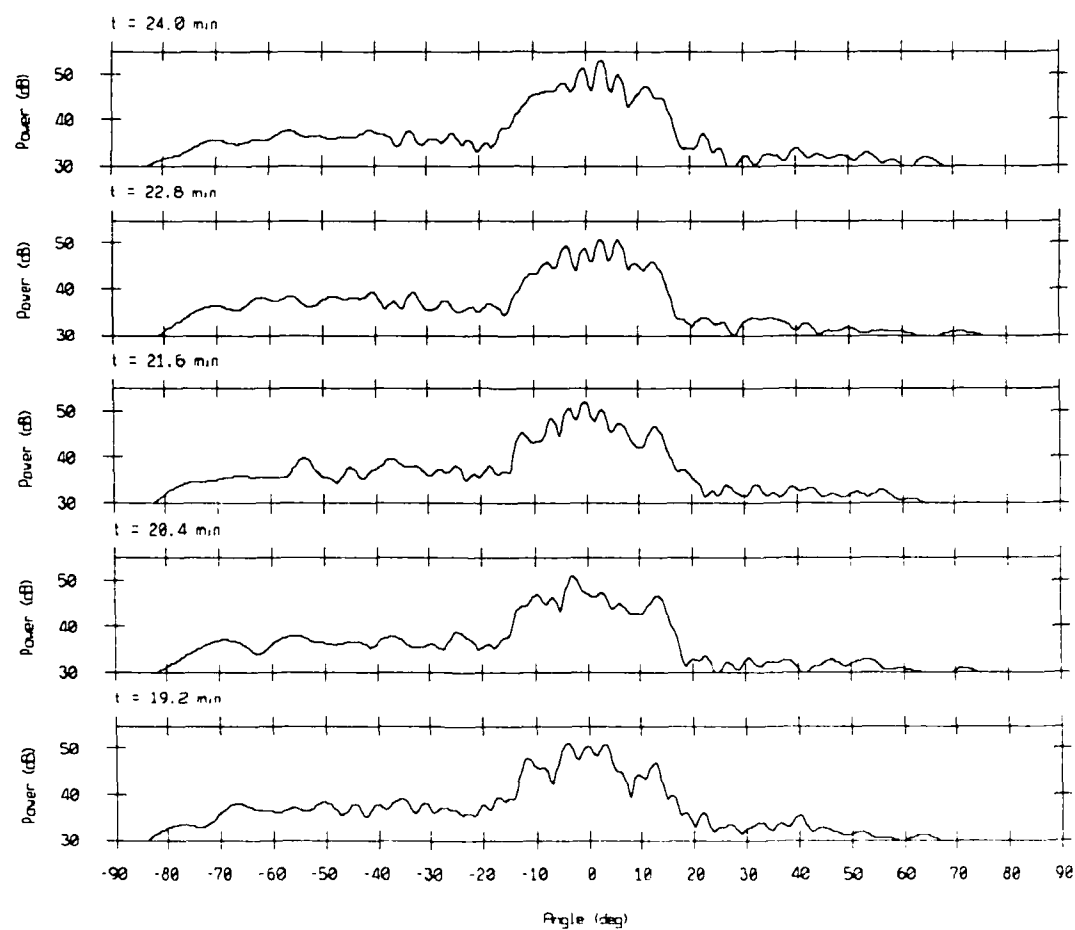
Array Response - 85210 Bin #6824

$f = 300$  Hz, rect window



Array Response - 85010 Bin #6804

$f = 300$  Hz, rect window



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